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Featuring articles on pollination, plant responses to fire, and more!

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Front cover: Woody fruits of *Banksia serrata* open after fire and release their seeds. Photo: Tony Auld

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Australasian Plant Conservation is a forum for information exchange for all those involved in plant conservation: please use it to share your work with others. Articles, information snippets, details of new publications or research and diary dates are welcome. General articles on any plant conservation issue are most welcome.

The deadline for the **Winter 2020** issue is 1 May. If you are intending to submit an article or wish to discuss possibilities, please email the editor, Heidi Zimmer: **editor@anpc.asn.au**.

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This issue

Regular features

From the editor

HEIDI ZIMMER

Welcome to the autumn edition of *Australasian Plant Conservation*. We lead this issue with an article on plant conservation and fire, written in response to the unprecedented bushfire season of 2019-2020. The principle author of this article is Tony Auld, eminent fire ecologist and incoming president of the Australian Network for Plant Conservation. Staying on the theme of fire, the next article is from Steve Taylor *et al.* and it addresses arguably one of the biggest plant conservation challenges associated with bushfire: post-fire weed invasion. Taylor *et al.* describe the invasion of a *Poa labillardierei* community in Namadgi National Park by *Carduus nutans*. This is followed by an article from Ren Bennett *et al.* which describes some of the challenges that high severity and short-interval fires pose for tree regeneration.

For more on the subject of bushfire and plants, you may also be interested in reading the article published in The Conversation (17 January 2020) on post-fire plant recovery (**https://theconversation.com/yes-native-plants-can-flourish-after-bushfire-but-theres-only-so-much-hardship-they-can-take-129748**) and when intervention might be needed, led by Lucy Commander (ANPC project manager), or the plants and fire factsheets on the ANPC website (**https://www.anpc.asn.au/bushfire-2019-2020-resource-page/**).

We then shift our focus to pollination. Liz Milla *et al.* give us an insight into the potential impacts of climate change on plant-pollinator communities through a case study at Kosciusko National Park, deftly using observations from studies in the 1980s to highlight changes (in plants and pollinators) which have already occurred. We then segue into news from the Australian Seed Bank Partnership, which is also focused on pollinators. Lena Schmidt *et al.* describe their study in which they evaluated which native plant species were most suitable for enhancement plantings in agricultural landscapes, to give maximum benefit to pollinator communities. Next we move to some of our regular features, with a report on the Declining Species workshop from Sue Brunskill. In our member profile we get to know our new ANPC president, Tony Auld. This is followed by book reviews, news and conferences and research round up, now presented by Tom Le Breton. We thank Kirstin Cowley for her valuable service to APC using her thoughtful research skills to provide us with research round ups for the past 16 years.

Plant conservation and fire

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We have just experienced the most extensive fires ever recorded in eastern Australia. It is timely to consider how fire influences our approaches to plant conservation, and the challenges that a changing climate brings.

How fire affects the persistence of plant species and vegetation communities

Fire plays a role in the development and structure of most Australian vegetation communities. Most vegetation communities are burnt at some time and, within these communities, fire affects the survival of plants and animals. The components of a fire can be thought of as a fire regime – this is fire frequency, severity, season, type (*e.g.,* surface, peat fire), extent and patchiness. These components interact to affect plant species survival at a site. So, in a very real sense, the impact of a fire on a plant at a particular site (including the current fires) depends on both the past fire history at that site and the characteristics of the current fire (severity, season, patchiness). Fires do not destroy bushland, as both plants and animals have strategies to survive fires and recover after the fire has passed. However, depending on the fire regime (*e.g.,* fire severity, frequency, type), some species may decline.

All plant species are not tolerant to all fire regimes, and building an understanding of the degree of each species' tolerance to each component of the fire regime is important for the long-term conservation of native vegetation. This is particularly the case under the expectation of more extreme fire weather and hence, more frequent fire in the near future.

What factors will govern whether or not a plant species can recover after these fires

The 2019-20 fires were unprecedented in extent and severity. While most plant species should readily recover after the fires, some will likely decline. This is due to a range of factors including:

- Increasing fire frequency reducing seed banks and increasing plant mortality.
- Increasing fire severity increasing plant mortality in resprouters and damaging some canopy seed banks.
- Post-fire grazing by horses, deer, rabbits, goats and stock, reducing or eliminating seedlings and resprouting plants.

***Banksia serrata* seedling after fire. Photo: Tony Auld**

- Weeds and pathogens acting as additional stressors, affecting growth and survival of seedlings and resprouts.
- Ongoing drought affecting seedling and resprouter survival.

We need to determine where these risks to recovery may occur, prioritise where declines would be particularly deleterious (*i.e.* threatened species, species sensitive to fire or very slow to recover (*e.g.,* rainforest and alpine species), species with low population numbers or very few populations) and carry out monitoring to observe how recovery progresses.

How plants persist after fire

Many plants can survive being burnt in a fire. These plants are called resprouting plants and they are often long lived. Examples of resprouting plants include eucalypts, many of which can resprout from buds protected by bark on the trunk; shrubs that resprout from underground lignotubers; and grasses, sedges and herbs that resprout from underground tubers and bulbs. However, the ability to resprout can vary (even within species), depending on things such as fire severity, plant size and location of dormant buds, drought and disease. To replace those plants that die either in a fire, or between fires, many resprouting plants also produce seedlings after fire and these seedlings need to persist and grow at least after some fires.

Other plants die when they are burnt, and these are called fire-sensitive plants or obligate seeders. In these species, if a plant is completely burnt or is close enough to the heat of the flames to have all its leaves scorched brown, it will die. These plants rely on regeneration from seed and they can be common in species-rich areas such as the heathlands of southwestern WA and Sydney sandstone vegetation. In other places, obligate seeders may be quite rare or absent. For example, grasslands, rainforests and alpine vegetation are dominated by resprouters.

Just because the aboveground plants of obligate seeders are killed by fire, does not mean they do not persist. Obligate seeders have seed banks that can survive fire and, as far as we know, it seems very few plants appear to rely on dispersal back into burnt areas to recover (mistletoes are one rare example, and they may survive in a fire if not scorched). Seed banks may be located on the plant in woody fruits that insulate the seeds from the lethal fire temperatures (*Banksia*, *Hakea, Lambertia*, *Callistemon*, *Melaleuca*, *Allocasuarina*, *Leptospermum*, *Eucalyptus*). Alternatively, seed banks may be held in the soil (*Acacia*, *Persoonia*, native peas (Fabaceae), *Dodonaea*, *Boronia etc.*), and the soil is a great insulator, protecting the seeds from the heat of the fire above.

Recruitment and flowering after fire

The environment immediately after a fire is very favourable for plant recruitment. Nutrients, released by the fire, are available to growing plants, and there is also abundant light and space – as fire has burnt, and in some cases killed, competing vegetation. Consequently, many plants in fire-prone communities recruit new individuals in the first few years after fire.

Fires promote seed germination in many species. Factors promoting seed germination (provided soil moisture and ambient temperatures are favourable) include: soil heating during and after fires (*e.g.,* physically dormant legumes and wattles); smoke (physiologically dormant species); and the interaction of these. Some resprouters have no seed banks at the time of a fire and need to flower soon after fire to recruit new plants. This can lead to spectacular floral displays in the first few flowering seasons after fire (*e.g.,* in *Xanthorrhoea*, *Telopea*, *Conospermum*, *Doryanthes*). In addition, there are other species thought of as 'fire ephemerals' because they appear (germinate, or resprout from below ground storage organs) after fire in relatively large numbers. These plants then flower and set seed, before largely disappearing from the aboveground vegetation. They await the next fire as seeds, bulbs, tubers etc in the soil. Some may be present aboveground for a very short time (<2 years) while for others it may take 10-20 years for all above ground plants to senesce.

Plant resilience to climate change and fire

The general consensus in climate change modelling suggests that Australia will experience an increase in the number of days with extreme/catastrophic fire weather, increased temperatures and ongoing episodes of drought. This is likely to lead to slower recovery of species after each fire. In temperate forests, increased frequency and severity of wildfires may occur, while in more arid and semi-arid areas there may be fewer fires as there is less fuel. Two characteristics of plants play key roles in their persistence: that is, storage of resources to allow resprouting and the maintenance of seed banks to buffer losses from the adult population. Both will be impacted by climate change.

Seed banks buffer plants against changes, but plants that rely on seed banks are vulnerable to 'interval squeeze' (Enright *et al.* 2015) where they do not have enough time to recover (grow to flower and produce seeds) between fires, and seed production may be reduced. Reductions in plant growth as a result of drought will both delay and reduce seed production after fire. Hence, it will increase the risk of a species being unable to recover from a short-interval fire (before the seed bank is replenished). This reduction in seed bank affects a plants' capacity to recover not only if it is killed by fire, but also from other disturbances such as drought, grazing or pathogens.

Pimelea **seedlings after fire. Photo: Tony Auld**

Patchy fire in heath. Photo: Tony Auld

Resprouting *Leptospermum*. Photo: Tony Auld

Temperature, on the other hand, affects how long seeds can remain viable in the soil: increased soil temperatures lead to increasing seed mortality or decay (Ooi *et al.* 2009). Temperature also affects dormancy loss and determines when the favourable window for germination occurs, particularly in species with physiological dormancy (Merritt *et al.* 2007). Species with a narrow range of temperature across which they will germinate are likely to be more greatly affected by a warming climate than species with a wide germination temperature range (Walck *et al.* 2011). Climate warming will change the seasonal opportunities for germination. For species with a requirement for cold temperatures prior to germination (cold stratification), areas of suitable climatic habitat are likely to decline, leading to shifts or contraction of distribution ranges. Species with a limited range are likely to be most affected (*e.g.,* mountain tops, edges of continents). Changes to rainfall will also affect available soil moisture and germination.

For resprouters, regrowth after fire is dependent on stored reserves and these reserves need to be replenished between fires. Short interval fires can lead to reduced resprouting capacity and increased rates of tree mortality (Fairman *et al.* 2019). Moreover, resprouters are unlikely to be able to rely on recruitment from seed to replace adults that die in such situations, as juvenile plants need sufficient time to become fire resistant. If drought is more common, a plant that resprouts after fire may also be more susceptible to the impacts of drought stress (embolisms in vascular tissue leading to death of new shoots).

Investing in *ex situ* seed banking and cultivated seed production (where feasible) for for high priority species (*e.g.,* threatened species that are amenable to long-term storage) is essential as a backup for their long-term conservation.

Finally, we need to plan for how to protect important plant species and communities in the wild under increasing conditions of more frequent and severe fires.

The success of actions to minimise the severity of the fires that burnt the Wollemi Pine illustrates what can be done or at least attempted. This type of planning may be needed to protect ancient rainforest remnants, long-lived conifers and other plants and vegetation that is of significance but cannot tolerate the fire regimes of tomorrow.

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Woody fruits of *Banksia serrata* open after fire and release their seeds. Photo: Tony Auld

Post-fire invasion of Nodding Thistle in a montane *Poa labillardierei* community

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Summary

A high severity fire in Namadgi National Park, ACT, killed significant numbers of the mature tussock grass *Poa labillardierei* Steud. (River Tussock). The fire took place in Autumn 2018, and resulted in an extensive *Carduus nutans* L. (Nodding Thistle) invasion the following spring. Nodding Thistle has become the dominant species along the valley floor (25 ha). Standard control measures with selective herbicide have been used but intensive rehabilitation is required (leaky weirs, grazing exclusion) to encourage native plant regeneration. Lessons learnt include: 1) montane River Tussock communities along riparian areas are sensitive to hot fire, particularly when under drought stress; 2) Nodding Thistle invasion supports the 'Augmented' Intermediate Disturbance Hypothesis; and 3) prolonged drought, associated with climate change, is lowering the tolerance of montane River Tussock communities to fire, and reducing biotic resistance to invasive plants.

Introduction

The Long Flat section of Grassy Creek in Namadgi National Park is located along the southern border of the ACT (1,124 m elevation). It is classified as River Tussock – Kangaroo Grass – Rush Wet Tussock Grassland of foot slopes, drainage lines and flats – Temperate Montane Grassland (ACTMapi 2019). It falls within the definition of a native grassland of the South Eastern Highlands bio-region. Native grasslands in this bio-region are listed as critically endangered (Department of Environment and Energy 2019).

The un-burnt *Poa labillardierei* (River Tussock) community is characterized by large tussock grasses which are up to 1 m in height, with a deep litter layer of old leaves and a network of fibrous roots, at varying states of decomposition, occupying the inter-tussock spaces (MacPhee 2019). This community structure makes it very resistant to invasion by exotic plant species. It also creates its own micro-climate which helps with drought resilience (Figure 1).

In early Autumn 2018 a hazard reduction burn was implemented in nearby forest and woodland.

Figure 1. Unburnt mature *Poa labillardierei* (River Tussock), Grassy Creek, Namadgi NP. Photo: Steve Taylor

An un-expected change in weather conditions caused an out of control wildfire. As part of an effort to contain the fire it was decided to back burn the adjacent River Tussock community. Prolonged drought resulted in a hot fire that severely damaged the grassland (MacPhee 2019). In the past the River Tussock creek flats have been wet enough to dampen fire intensity.

By spring 2018, *Carduus nutans* L. (Nodding Thistle) had invaded burnt River Tussock along the river flat, becoming the dominant plant (Figures 2 and 3). The Parks Ranger for the area raised the alert of the need for management intervention. This has led to a combination of standard weed control plus preparation of a rehabilitation plan.

Nodding Thistle is listed as a weed of agricultural areas (CABI 2019). It is a biennial herb, native to northern Africa and parts of Europe and Asia. In SE Australia, Nodding Thistle and other *Carduus* species are regarded as weeds of disturbed areas and bushland (Richardson *et al.* 2016).

In Namadgi National Park, Nodding Thistle spreads rapidly in disturbed areas. Once established, it continuously seeds and germinates through the growing season, creating very persistent infestations.

In the absence of strong perennial grass competition, ongoing recruitment of dense patches of Nodding Thistle rosettes prevents native plant succession. The rapidly accumulating seed creates an infestation hub for further spread. If propagule pressure from the hub is high enough then further spread occurs into the inter-tussock spaces in un-disturbed grassland. In this way Nodding Thistle steadily increases its seed bank across the landscape. Using the Passenger-Driver model – it would be classed as a 'back-seat' driver in Namadgi National Park (Chabrerie *et al.* 2019).

The post-disturbance dominance of Nodding Thistle at Grassy Creek is a good example of the 'Augmented' Intermediate Disturbance Hypothesis (Catford *et al.* 2012). The removal of River Tussock competition and release of resources from the fire allowed Nodding Thistle, an excellent coloniser, to invade the entire burnt valley flat. Early stages of succession are particularly vulnerable to such introduced plants. The problem is compounded because Nodding Thistle has escaped the life-history trade off. It has novel traits for this environment, which also make it competitive at the mid-succession stage as well. The traits are: larger size compared to most of the native grassland plants, production of relatively more seed with higher rates of germination, and when there is sufficient seed it has an allelopathic effect on the seeds of other plant species (Wardle *et al.* 1991). This allows it to persist at high density levels post disturbance, particularly when competitive native perennial plants have lost their fitness. The result (without management intervention) is reduced native plant populations (reduced diversity) as predicted by the 'Augmented' Intermediate Disturbance Hypothesis.

At the Grassy Creek site, a formerly resistant native plant community has become low quality habitat. This makes it more vulnerable to invasive plant spread (Hui and Richardson 2017).

Figure 2. Post fire *Carduus nutans* (Nodding Thistle invasion), rosette stage, Grassy Creek, Namadgi NP. Photo: Deklyn Townsend

Figure 3. Post fire *Carduus nutans* (Nodding Thistle) invasion, flowering stage, Grassy Creek, Namadgi National Park. Photo: Steve Taylor

Material and Methods

Mapping of the Nodding Thistle invasion was undertaken with the Collector for ArcGIS app using an on-device or off-line map (Esri 2019). The cover was recorded using a pick-list within the polygon feature layer using modified DAFOR categories (Rare <1%, Occasional 1-10%, Frequent 11-25% and 26-50%, Abundant (51 to 75%, Dominant > 75%). There had been previous weed mapping in the area of the burn so a comparison of density of Nodding Thistle could be made post-fire.

Three plots (5 m x 5 m) were established to count the numbers of live and dead River Tussock plants. Photo-points were also set up for these plots. Presence of native colonisers were also noted if present. The plots were placed at the bottom, midway and near the top of the burnt creek flat.

Initial control of the large and dominant Nodding Thistle infestation (25 ha at > 75% cover) was undertaken in early summer of 2018, using aerial spraying with the label rate of the selective herbicide Lontrel (clopyralid). The sprayed areas were mapped on the Collector app. This was compared with pre-fire mapping of Nodding Thistle.

Follow-up spraying occurred in late spring 2019, because there were still abundant Nodding Thistle rosettes preventing native plant regeneration. Based on experience elsewhere in Namadgi National Park, there will have to be ongoing herbicide control until native plant cover increases.

Consultancy Alpine Flora was engaged to assess the need for restoration work to encourage native

plant regeneration to compete with the Nodding Thistle and other exotic herbaceous plants, such as *Verbascum thapsus* L. (Great Mullein) (MacPhee 2019). Grazing exclusion, mulch, wetting agents, leaky weirs (which use materials such as Coir logs to slow water movement and pond water up stream of the weir) and revegetation were planned to encourage native plant regeneration. The aim was to find which techniques deliver the best results, and then apply these across the entire area. Photo-point monitoring and simple vegetation cover measures were used to evaluate management intervention effectiveness.

Results and Discussion

The pre-fire density of Nodding Thistle at Grassy Creek was Rare (Figure 4). It was mainly spreading along the disturbed Long Flat fire trail edge. Spot spraying control with Lontrel kept the density at low levels. The post-fire infestation increased substantially. Clearly there was a large suppressed Nodding Thistle seed bank, waiting for such a large-scale disturbance.

Some advice received by the area Ranger delayed immediate management intervention, including: 'don't worry the Poa will re-sprout and out-compete the Nodding Thistle.' The Ranger became increasingly concerned when there was no sign of re-sprouting and following observations that a high proportion of the River Tussock had died. The root mass had burned up into the base of the plants so that they fell out of the ground (Figure 5).

Clearly there has been high mortality and damage to the River Tussock (Table 1). Mortality may increase as the surviving plants have have shown limited resprouting. They have also been under continued drought stress and increased grazing pressure. A firefighting dam nearby helps sustain Eastern Grey Kangaroo numbers and exacerbates grazing pressure (Ranger D.Roso pers. com).

Nodding Thistle became the dominant plant by Spring 2019, approximately 18 months post-fire. The Autumn 2019 survey confirmed that 'do-nothing' was not an option because:

- Death of River Tussock plants left gaps where Nodding Thistle could dominate and out-compete native plant colonisers, *i.e.* prevent native plant succession.

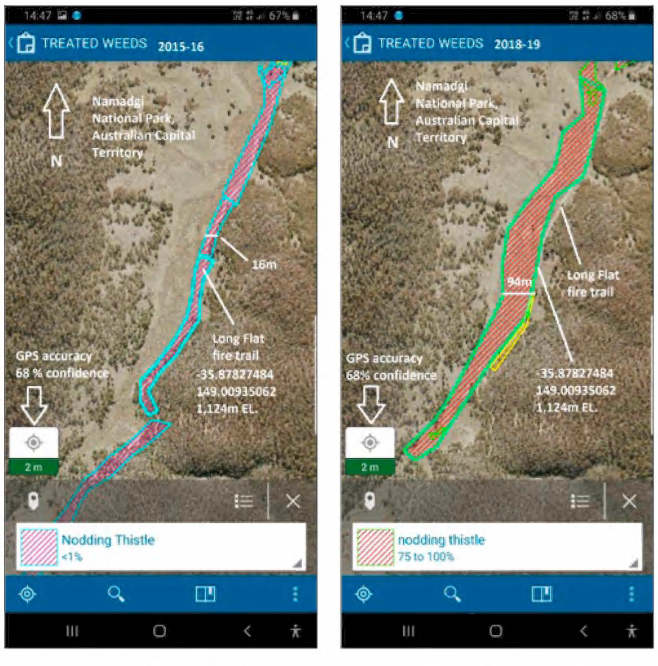

Figure 4. a) Collector for ArcGIS app screenshot of pre-fire density. b) Collector for ArcGIS app screenshot of post fire density (part of total infestation area).

Figure 5. Dead *Poa labillardierei* (River Tussock) from Plot 1. Photo: Steve Taylor

Table 1: Response of River Tussock (*Poa labillardierei*) to a hot fire at Grassy Creek (Plots 5 m by 5 m).

Date	Plot 1 (lower section) Number of *Poa* with leaves	Plot 2 (mid-way) Number of *Poa* with leaves	Plot 3 (top section) Number of *Poa* with leaves	Comments
March 2018 immediately pre-fire	57	42	45	At least this number as some were completely incinerated.
Post fire April 2019	17	7	13	Minor re-sprouting and grazed.
December 2019	17	7	12	Minor re-sprouting and grazed. Plot 3 with a few juvenile River Tussock?

Source: https://inaturalist.ala.org.au/observations/22185088, https://inaturalist.ala.org.au/observations/22185095, https://inaturalist.ala.org.au/observations/22185115

- Nodding Thistle is known to have a competitive advantage during drought (Parsons and Cuthbertson 1992).
- Leaving 25 ha of Nodding Thistle to spread seed through surrounding grasslands would have created multiple new infestations throughout the Naas Valley of Namadgi National Park.

The scale and density (approx. 25 ha at > 75% cover Nodding Thistle rosettes) of the infestation meant that spot spraying was not feasible (Figures 2 and 3). Difficult terrain meant that helicopter spraying was the best option. Label rates of Lontrel (Clopyralid) were used effectively. Spraying was delayed but still managed to stop the elongated Nodding Thistle from multiple seeding events (Figure 6).

Successful follow-up control was undertaken by both helicopter and ground crews in spring-summer 2019-20.

Ongoing control will be needed until the restoration techniques sufficiently re-wet the soil and thereby encourage the growth of *Carex* sp. and River Tussock. Unfortunately, the prolonged drought has delayed implementation of the proposed restoration techniques.

Conclusion

The combination of a hot fire, drought and grazing pressure severely damaged a montane River Tussock grassland. The resulting Nodding Thistle invasion (predicted by the 'Augmented' Intermediate Disturbance Hypothesis) adversely affected native plant succession, requiring multi-faceted management intervention.

Disturbance and propagule pressure are clearly drivers of this example of invasive plant spread. Further post-fire spread of Nodding Thistle to surrounding un-burnt grassland was avoided by decisive management, rather than the wait and see approach.

Figure 6. *Carduus nutans* (Nodding Thistle) killed by aerial spraying at Plot 1. Elongation from the rosette stage to the flowering stage occurred before herbicide could take effect. Further flowering and seeding was prevented. Photo: Steve Taylor

It is too early to say if the burnt River Tussock grassland can be fully restored. It may be a relic plant community from a wetter and cooler period, sustaining itself with a dense mulch layer and shading from the larger tussock grasses. The leaky weir restoration technique may be the best approach to help restore the area.

National Parks staff are discovering that climate change and prolonged drought are making hazard reduction burning and fire suppression techniques, such as back burning, more difficult. Native plant communities that formerly rarely burnt, and if so only at low intensity, are now burning readily and completely, at a high intensity.

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Why Australia's severe bushfires may be bad news for tree regeneration

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Blackened tree stems are all that remain in many post-fire images of eastern Victoria. The charred, often leafless trees are a testament to the severity of this season's bushfires, which have had a devastating impact on the state's biodiversity (**https://www.theage.com.au/national/victoria/leaked-report-lays-bare-environmental-devastation-of-victorian-fires-20200110-p53qep.html**).

How the trees respond to the fires is crucial to environmental recovery since most of the burned ecosystems are forests, and trees are the backbone of forests.

Figure 1. A range of tree species dominate the forests of East Gippsland. Photo: Benjamin Wagner, University of Melbourne

Until recently, we could be confident that most of the trees in our forests would recover from most fires, but that confidence is wavering. While it is too early to accurately quantify what has been burned in the latest fires, our preliminary analysis comparing maps of the fire boundaries against maps of vegetation classes indicates that a broad range of forest types and tree species have been affected.

Most of the burned area is in mixed-species eucalypt forests, which are common throughout eastern Victoria. But the fires have also burnt forest types of more limited distribution including banksia woodlands, warm temperate rainforests, and mountain communities including alpine ash forests and snow gum woodlands.

Mixed-species eucalypt forests are characterised by combinations of fire-tolerant eucalypts, from smooth 'gums' to rough 'stringybarks'. These tree species reliably survive most fires by resprouting from buds that arise deep in the stem and/or swellings at the base of the tree, called lignotubers. Some species, like snow gum, re-sprout solely from the lignotuber because their stems are usually killed by fire. Even some rainforest trees like the lilly pilly have evolved to re-sprout after fire, although less convincingly than the eucalypts.

Many tree species can also persist after fire through germination of seeds on the ash bed. Some eucalypts, like alpine ash, are killed outright by high-intensity fire and regenerate en masse after fire from seeds that are stored in the canopy. Many species in mixed-species eucalypt forests also regenerate from seed after fire, but this trait is far less common in rainforest trees.

If our trees are so adept at persisting after fire, why are we concerned about their recovery after this season's fires?

The answer is that not all fires are equal. The intensity and the frequency of fires has a big impact on the post-fire recovery of tree populations.

A fire's intensity is a measure of the energy released. Higher fire intensity usually results in higher fire severity, meaning stronger impacts on the ecosystem – tree crowns are consumed rather than scorched by fire, for example. Our trees have adapted to historical fire intensities, which have ranged from low for rainforests, to very high for the highly productive alpine ash forests. Moist gullies, for example, usually moderate the intensity of landscape-scale fires, providing refuge for fire-sensitive rainforest species.

This season's fires are of concern due to their sheer scale, resulting from prolonged dry conditions and very low fuel moistures, combined with 'unrelenting' severe fire weather (Nolan *et al.* 2020)

By all accounts, these fires have burned all in their path – not stopping for gullies – meaning that rainforests have likely burned at intensities well beyond their

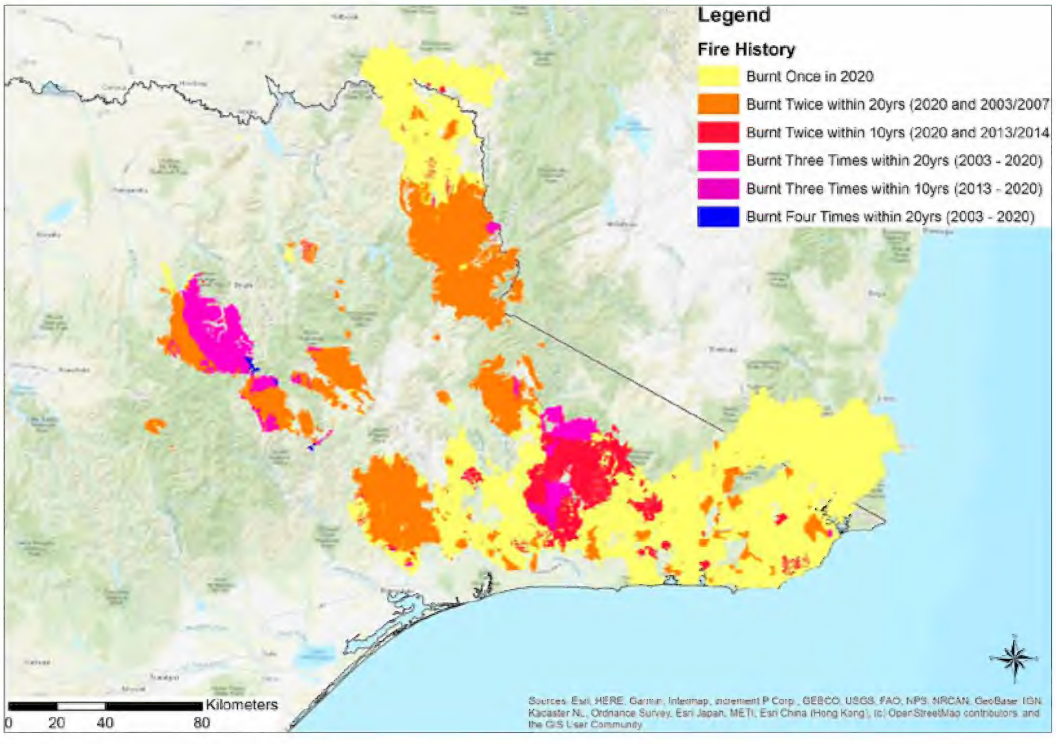

Figure 2. Some parts of Eastern Victoria have been repeatedly burned by bushfire in recent decades. Fire boundary data from https://www.emv.vic.gov.au/ and https://www.data.vic.gov.au (accessed 22/1/2020).

historical range. Such high fire intensities might even challenge the re-sprouting capacity of the most fire-tolerant eucalypts. Our research of the impacts of Victoria's 2009 Black Saturday fires on mixed-species eucalypt forests found that high-severity fire significantly increased eucalypt death rates (Bennett *et al.* 2016).

Tree persistence after these fires will also depend on when they were last burned and when they burn in the future. Our recently compiled fire map indicates that areas burned by large fires in 2003, 2007 and 2013/14 in eastern Victoria have again burned in 2019/20. This continues a trend of a marked reduction in the intervals between large-scale bushfires in Victoria since the early 2000s (Fairman *et al.* 2015).

Intervals between successive fires are important because trees need sufficient time to recover their regenerative capacity. Eucalypts like alpine ash are particularly vulnerable because they need about 20 years before trees regenerating after one fire will have sufficient seeds for successful regeneration after the next. Two high-severity fires in quick succession (2002/03, 2006/07) have led to the near elimination of alpine ash from some areas in Victoria's Alps (Bowman *et al.* 2013).

Re-sprouting success can also be reduced by short-interval fires. Two high-severity fires in 2007 and 2013 in West Gippsland decreased re-sprouting success of fire-tolerant eucalypts in mixed-species forests (Fairman *et al.* 2019). The proportion of snow gum trees killed outright by fire increased to 50 per cent after three high-severity fires in 2003, 2007 and 2013 (Fairman *et al.* 2017). In both cases, there was also a decrease in tree regeneration from seed.

Figure 3. Multiple bushfires in quick succession have severely depleted alpine ash populations in some parts of Victoria. Photo: Tom Fairman

What can be done?

Our trees have evolved with fire and most need some fire for renewal, but lately many of our forests have had too much severe fire. This pattern seems set to continue given projections of a hotter, drier climate for eastern Australia (**https://www.csiro.au/en/Showcase/state-of-the-climate**).

Practices that reduce the extent and frequency of severe bushfires in coming years will improve the overall chances of tree survival and population recovery.

Figure 4. Long-unburnt snow gum woodland (left) contrasted with one burnt by three severe fires in quick succession (right). Photos: Tom Fairman

This will involve continued efforts to reduce bushfire ignitions, to quickly suppress uncontrolled fires on extreme fire days, and to reduce forest fuel hazards through, for example, low-intensity prescribed burns. Intensive care might be required where rare trees are threatened by fire, as in the recent mission involving water bombing and irrigation to save the Wollemi pines north of Sydney (**https://www.smh.com.au/environment/conservation/incredible-secret-firefighting-mission-saves-famous-dinosaur-trees-20200115-p53rom.html**).

We could also consider the principles of ecological restoration in treating the negative effects of fires on natural ecosystems. This will in part involve assessing fire impacts and identifying when interventions will be required to assist recovery towards defined target ecosystems (Gann *et al.* 2019). Aerial sowing of seeds has been used to restore alpine ash to repeatedly burned areas in Victoria's Alpine National Park (Bassett *et al.* 2015). Similar measures, which are reliant on comprehensive seed banks (**https://www.abc.net.au/radio/programs/pm/insufficient-seed-to-reforest-after-hellish-bushfire-season/11883948**) might be required into the future to maintain the species mixes and structural integrity of other forest types including rainforests, snow gum woodlands and even mixed-species eucalypt forests.

Our trees are an important component of our biodiversity and are also central to the land carbon sink. We need them to recover to continue their life-giving service of removing carbon dioxide from the atmosphere to balance our ongoing emissions – including those from this season's fires.

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Plant-pollinator communities in the Australian Alps

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Background

Alpine and arctic environments experience extreme abiotic conditions, and thus are very vulnerable to climate change. Alpine habitats are highly restricted in Australia, representing around 0.09% of total land cover, with 15% exclusively alpine flora (Figure 1, Costin *et al.* 2000). These communities are characterised by short seasonal growth periods and snow-dependent vegetation. There is evidence that a reduction in snow cover and an increase in mean annual temperature are already having an effect in the Australian Alps (McGowan *et al.* 2018). Higher temperatures and increased fire frequency have been shown to increase the growth rate and recruitment of shrubs (Camac *et al.* 2017), allowing an upwards expansion of their range. Earlier melting of snow patches coincides with earlier flowering of some alpine plants (Green 2010), and mismatches with day length are predicted to affect the growth of late-snow constrained species (Venn and Morgan 2007).

At higher altitudes, conditions are often unfavourable for vertebrates and larger invertebrates; thus, insects play a major role in the pollination of alpine plants. The flow-on effects of changes in plant community composition on associated insect communities are unclear. Most studies of alpine pollinators have been restricted to Europe and North America, with few studies about the insect pollinators of the Australian alps (Inouye and Pyke 1988; Green 2010; Johanson *et al.* 2018). A detailed study in the mid-1980s identified flies as the most abundant pollinators in alpine sites (Inouye and Pyke 1988), and a recent study of alpine bees found that introduced European honeybees (*Apis mellifera*) are likely to be competing with native bees for floral resources (Johanson *et al.* 2018).

The aim of our study was to describe the current composition and structure of alpine plant-pollinator communities in Kosciuszko National Park (Figure 2). In this study, we used an ecological network approach to infer community structure. This approach is widely used to study other types of ecological interactions, such as food webs, host-parasite associations and plant-herbivore communities. One of its main advantages is the ability to identify key or vulnerable species by the number of direct and indirect interactions with other species. Ecological interaction networks can be represented as a matrix, with a square at the intersection between a pair of species denoting the interaction. In plant-pollinator networks, plants and insects that occur within a defined geographical area are shown on the axes, and each square represents the insect species visiting the plant's flowers (Figure 3). The darkness of the square is

Figure 1. Examples of vegetation in the alpine area. A. Short alpine herbfields are mainly composed of diverse species of small, herbaceous plants. B. *Caladenia alpina*, one of the orchids found at Charlotte's Pass. Photos: Liz Milla

Figure 2. Some of the interacting plants and pollinators at Kosciuszko National Park. A. Fly on Mueller's Snow-gentian (*Gentianella muelleriana*); B. Native bee on *Celmisia*; C. Native bee on Dandelion (*Hypochaeris radicata*); D. European honeybee (*Apis melllifera*) on *Nematolepis ovatifolia*. Photos: Liz Milla

related to the number of visits. For instance, in Figure 3, *Celmisia* receives few visits from true flies (Tachinidae) but several visits from bush flies (*Musca vetustissima*). The frequency and number of interactions and the relative abundance of the interacting species partly determines their degree of specialisation. For example, many orchids are known to have a single pollinator species, representing only one interaction and therefore are considered highly specialised. Specialised species tend to be at higher risk of extinction. Conversely, species with many interactions are considered generalists, and tend to be key species that maintain the stability of the community. Ecological network properties, such as modularity, can be used to predict the community's robustness against disturbances and reveal the structure of the web. Modularity measures how compartmentalised the network is by detecting the number of groups of species that have significantly more interactions with other species within the group than with species outside the group. Groups are highlighted by squares surrounding groups of interactions within the network matrix.

Vegetation survey and pollinator observations

During December, February and March 2017-18, we recorded the frequency of visits to plants by insect pollinators in an alpine area in Charlotte's Pass, Kosciuszko National Park, along Kangaroo Ridge and Mt Stilwell. We sampled seven plots with 50 m transects located in the alpine zone, defined as altitudes above 1940 metres. The plots were located across four types of alpine habitats: short alpine herbfield, tall alpine herbfield, shrubby heathland and feldmark. Within five metres of each transect we observed randomly selected patches of flowering vegetation in five-minute blocks for a total of 45 minutes each, identifying all plants and recording all insect visits to the fertile parts of flowers within the patch. Whenever possible, we trapped the insects for identification at the Australian National Insect Collection (ANIC). Using the flower-visitor observation data, we built a plant-pollinator interaction network (Figure 3) and calculated the following community and network metrics: modularity, degree of specialisation (H2', which measures overall level of specialisation of the web) and Shannon's species diversity index (Table 1).

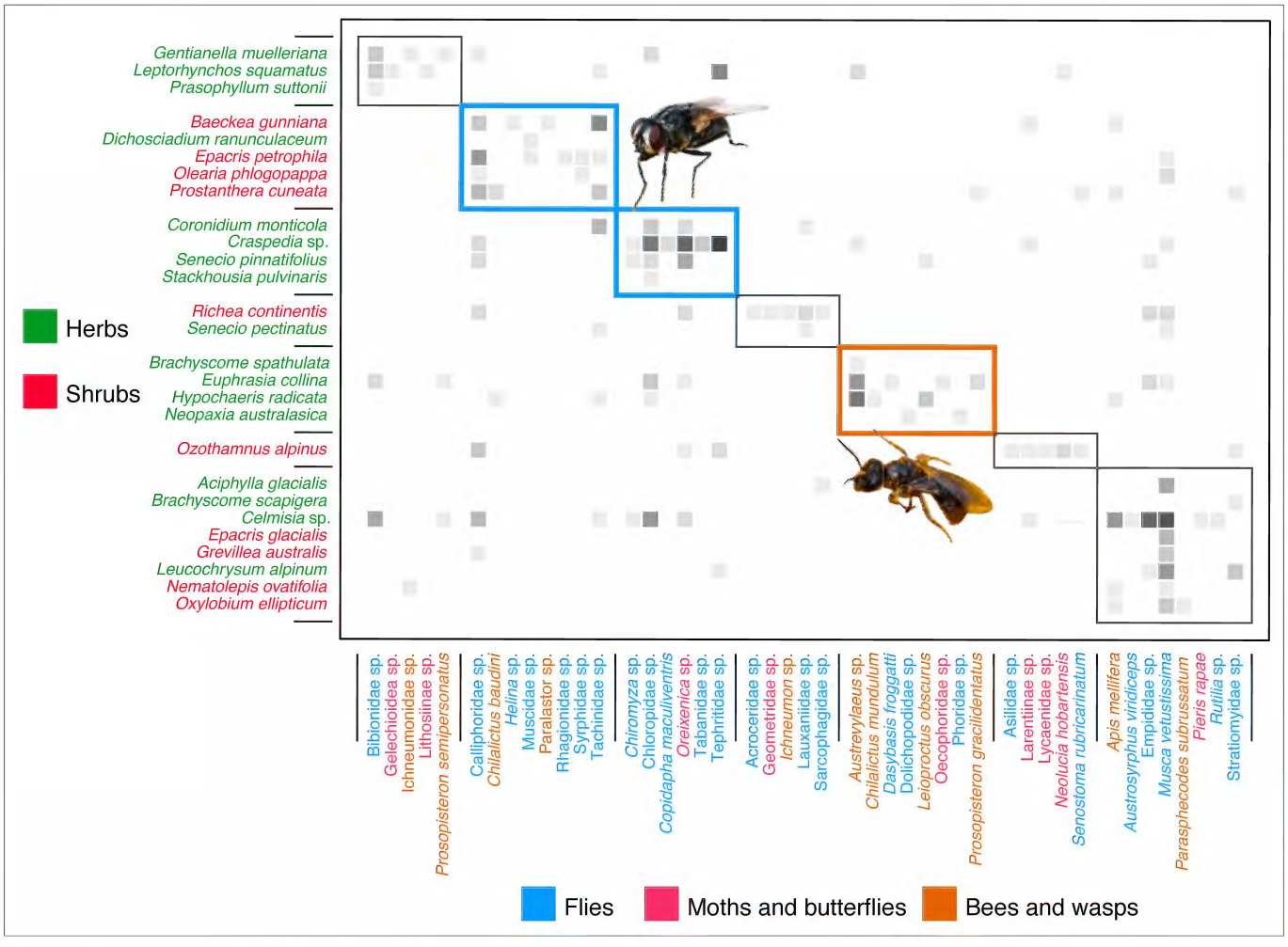

Figure 3. Alpine plant-pollinator network from Kosciuszko National Park. Plant species are on Y axis, insect species are on X axis. Boxes indicate groups (modules) of interacting species; fly-dominated groups are coloured blue and bee-dominated group is coloured orange. Inset photos: Liz Milla.

Table 1. Kosciuszko plant-pollinator network metrics comparing results from 1983-84 (Inouye and Pyke 1988) to 2017-18. Metrics calculated using R package bipartite, metric name in brackets.

Metric	1983-84	2017-18
Degree of specialisation (H2')	0.38	0.43
Species diversity index (Shannon's)	4.38	4.44

Plant and pollinator community changes

During our pollinator study, we recorded a total of 24 flowering plants and over 45 insect species, several of which could only be identified to family level. The three plant species with the largest diversity of insect visitors and the most recorded visits were herbaceous plants: *Celmisia* spp. (14 insect species and 56 visits), *Craspedia* spp. (10 insect species and 48 visits) and *Euphrasia collina* (10 insect species and 20 visits). However, the largest numbers of flowers in the observed patches were produced by *Aciphylla glacialis,* and three shrubs: *Grevillea australis, Epacris glacialis* and *Nematolepis ovatifolia*.

The shrubs visited by the most species of insects were *Ozothamnus alpinus* (9 insect species) and *Prostanthera cuneata* (7 insect species), but those with the most visits recorded were *Richea continentis* and *Baeckea gunniana* (14 visits each). The most highly specialised plant species were herbs, including two rare species of *Brachyscome* (*B. scapigera* and *B. spathulata,* one flower and one insect visit each) and the more abundant *Dichosciadium ranunculaceum* (40 flowers and one insect visit recorded).

Our network analysis identified seven distinct groups (modules) of interacting species. Two of those groups (highlighted in blue) were largely fly-pollinated. Overall, flies were the most common pollinators, visiting the largest number of flowers and the largest diversity of plants. One of the fly-dominated groups included several shrubs, including *Baeckea gunniana*, *Prostanthera cuneata* and *Epacris petrophila*, and was visited most commonly by blowflies (Calliphoridae) and true flies (Tachinidae). The other group was composed solely of herbaceous species, including *Craspedia, Coronidium monticola* and *Stackhousia pulvinaris*. This group was mainly visited by fruit flies (Tephritidae) and March flies

(*Copidapha maculiventris*), as well as *Oreixenica*, the most abundant and generalist of the moths and butterflies. A different group of herbaceous species, including *Brachyscome spathulata*, *Hypochaeris radicata* and *Euphrasia collina*, was dominated by native bees including halictid bees (*Austrevyleaus* sp.) and plaster bees (*Leioproctus obscurus*). *Euphrasia collina*, which produces tubular purple flowers and is an example of a typical "bee-pollination syndrome" plant, was visited by the most bee species. Native halictid bees were one of the most generalist bee pollinators; however, the European honeybee (*Apis mellifera*) visited a greater diversity of plant species.

To understand potential changes in alpine plant-pollinator communities, we compared our observations to those from a 1983-84 study of the same area (Inouye and Pyke 1988). Our records showed that shrub species are more common in the area, compared to the early 1980s. *Nematolepis ovatifolia* and *Grevillea australis*, for example, were observed flowering at altitudes not previously recorded. We also detected the arrival of the introduced species *Hypochaeris radicata* and *Apis mellifera* into the alpine zone. A comparison of the metrics for both networks (Table 1) suggests that while there has been a general increase in species diversity since 1984, there has also been an increase in the number of specialist species, leading to potentially more threatened species.

Implications for conservation

Alpine perennial herbaceous daisies, particularly *Celmisia* and *Craspedia,* are likely to be key species in the Kosciuszko alpine plant-pollinator community, attracting a diversity of insect species. Other herbaceous plants, such as the Mauve Leek-orchid (*Prasophyllum suttonii),* are more specialised and potentially at higher risk of extinction. The increased presence of flowering shrubs within the alpine zone may lead to a reduction of available habitat for smaller herbs, threatening their survival. Earlier flowering of snow-dependent herbs, such as *Gentianella muelleriana*, has been already recorded (Green 2010). In the early 1980s, *G. muelleriana* was visited by nine distinct insect species; however, we detected only five insect species visiting in 2017-18, suggesting a loss of available pollinators. The appearance of the invasive Dandelion and the European honeybee in the alpine zone is also a concern. Bees are important pollinators in many ecosystems, and in the alpine zone they appear to rely more heavily than before on shrub species and weeds for their diet. This may further contribute to the advancing spread of these plant species. Overall, these results suggest that over the last three decades, the plant-pollinator community at Charlotte's Pass has lost robustness and become more susceptible to disturbance.

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News from the Australian Seed Bank Partnership

The news from the ASBP focuses on a project that identified invertebrate pollinators associated with a collection of native species from the critically endangered Cumberland Plain Woodland community in Western Sydney.

The project demonstrates that targeted plantings of locally adapted, native plant species could increase floral resources for resident pollinator communities. Greening Australia's large scale seed production area was the basis for the work and demonstrates the valuable research and training opportunities generated through this type of production.

Restoration of native wildflower patches in agronomic settings for diverse and healthy pollinator populations

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Globally, about 88% of angiosperms rely on animal pollinators to set seed and reproduce (Ollerton *et al.* 2011). Pollination is therefore a critical ecosystem service, underpinning plant reproductive success and, for crop species, associated yields. Many horticultural crops, including the economically and locally important apple industries, are reliant on insect pollination (Rogers *et al.* 2014). Yet while there is a wide range of native pollinating insects (including wasps, bees, flies, butterflies, hoverflies and ants; Figure 1) most agronomic systems focus heavily on a single pollinator – the European Honeybee (*Apis mellifera*). Honeybee hives are typically brought onto farms for specific crop flowering periods, a practice that has not only high financial costs to farmers, but a high risk associated with dependence on a single pollinator, especially in the context of disease threats (notably Varroa Mite) to this species. Moreover, many fruit crops get added benefits from pollination by wild pollinators, even when Honeybees are abundant (Garibaldi *et al.* 2013). Hence it is vital to support resident pollinator populations in cropping landscapes.

Prolifically flowering native species can provide valuable floral resources for wild pollinators, offering a varied diet of diverse pollen and nectar sources. However, the quantity and quality of nectar and pollen reward can vary significantly between plant species and, for certain insect species, foraging specialisation coupled with adaptations to specific floral morphologies can limit realised resource availability. This highlights the importance of having a broad range of native flowering plants within the landscape to support diverse pollinator assemblages.

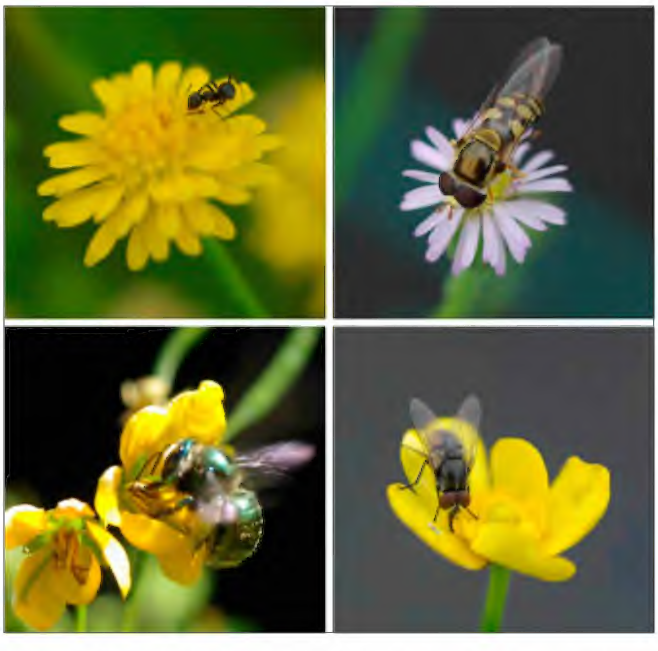

Figure 1. A range of native pollinators observed on flowers of Cumberland Plain Woodland floral species during the study. From top left to bottom right: ant (*Myrmecia* spp.) on *Calotis lappulacea*, hoverfly (*Simosyrphus grandicornis*) on *Calotis cuneifolia*, Peacock Carpenter Bee (*Xylocopa bombylans*) on *Senna barronfieldii* and fly (*Diptera* spp.) on *Ranunculus lappaceus*. Photos: Lena Alice Schmidt

Despite this, native vegetation across the Greater Sydney Region is still being cleared to make way for housing, infrastructure and agriculture. This widespread habitat loss and fragmentation is associated with ongoing loss of native floral resources with knock-on effects for pollinator health, diversity and abundance.

Within highly modified landscapes, local enrichment of native plant species that provide diverse floral resources over a substantial part of the year could play a vital role in maintaining and improving wild pollinator population sizes and health. Although mass-flowering farm monocultures (*e.g.,* Canola (*Brassica napus*)) offer insects a short-term bountiful resource, these landscapes typically have few floral resources outside of these short flowering windows. Targeted plantings of locally adapted, native plant species which flower progressively throughout the year could increase floral resources for resident pollinator communities, especially outside of crop flowering times. However, relatively little is known about how different Australian pollinator groups exploit and benefit from the floral resources available across the landscape, or how plant species differ in their relative contributions to resource provisioning throughout the year.
Species selection for native floral enhancements, and therefore their success in supporting native pollinators, depends largely on the floral traits and flowering phenology of the plant species, and foraging preferences of the pollinators. Other contributing local factors include pollinator community species composition, microclimate and landscape context, specifically the amount and quality of floral resources available within the local landscape matrix (Prýs-Jones and Corbet 1991, Mader *et al.* 2011).

To evaluate which native species might be suitable for enhancement plantings, we quantified floral traits, and surveyed pollinator visitation rates, for a range of phylogenetically and morphologically diverse native plant species (Figure 2). For this, we worked with species belonging to the critically endangered Cumberland Plain Woodland (CPW) vegetation community. Our study site was the Greening Australia Cumberland Seed Production Area (SPA) located at the Hawkesbury Campus, Western Sydney University, NSW, Australia (33°36'31.9"S 150°44'20.8"E).

From April 2018 to May 2019, we surveyed flower abundance and associated pollinator visitation, developing a floral calendar for 41 herbaceous species and also collected nectar and pollen samples to evaluate floral reward quantity and quality. We were able to quantify the temporal dynamics of floral resources year-round, thus identifying when resident pollinators may face food shortages. Plant species differed in the length and timing of their floral windows, with year-round flowering observed for only a few (*e.g., Goodenia hederacea*). While a large proportion

Figure 2. Varying morphological traits of a subset of Cumberland Plain Woodland floral species selected for the study. From top left to bottom right: *Plectranthus parviflorus*, *Chrysocephalum apiculatum*, *Rhodanthe anthemoides*, *Senna barronfieldii*, *Linum marginale*, and *Arthropodium* sp. B. Photos: Lena Alice Schmidt

of species flowered for periods of six to seven months (*e.g., Wahlenbergia communis*), others showed a much more restricted floral window (*e.g., Bulbine bulbosa,* which flowered for only three months). Peak flower abundance differed between species, with some species experiencing double peaks in their flowering phenology (*e.g., Pimelea spicata*). Analysis of flower visitation data will allow us to determine whether pollinator visits simply track flower abundance or whether there is evidence of species-specific foraging preferences. These data will also provide valuable insights into which floral traits are associated with the greatest diversity and abundance of pollinator visitation.

From these 41 species we have selected a subset of 23 that successively flower throughout the year and represent diverse morphological traits, including various flower colours and sizes, and nectar quantities. These provide year-round continuity of resources, and have been shown to attract a diverse array of native pollinators. We have now established plantings (floral strips) to test differences between native and non-native (exotic) species (where non-natives typically have a shorter flowering window) in terms of attracting and provisioning native pollinators (Figure 3). For this, we are conducting pollinator observations every month over the course of one year. Our aim is to determine which species are most important for providing floral resources to resident pollinator communities, and how their relative contributions to resource provisioning changes throughout the year.

Native floral strips have the following species composition: *Arthropodium* sp. B, *Calotis cuneifolia*, *Calotis lappulacea*, *Chrysocephalum apiculatum*, *Convolvulus erubescens*, *Coronidium scorpioides*, *Craspedia variabilis*, *Dianella longifolia*, *Dichopogon fimbriatus*, *Geranium solanderi*, *Hypericum gramineum*, *Linum marginale*, *Murdannia graminea*, *Plectranthus parviflorus*, *Podolepis jaceoides*, *Rhodanthe anthemoides*, *Senecio quadridentatus*, *Senna barronfieldii*, *Viola betonicifolia*, *Vittadinia cuneata*, *Wahlenbergia communis* and *Wahlenbergia gracilis*. Exotic floral strips include 23 non-native species from a commercially available bee and butterfly flower mix.

Our study tests the role that native floral enhancements can play in supporting diverse and healthy pollinator populations across Australian landscapes. This, we hope, will support the reintroduction of native plant species, including those belonging to critically endangered communities, into agricultural landscapes. The restoration of small patches of species-rich native vegetation has the potential to provide refuges and resources over prolonged periods, helping to increase local biodiversity. In agronomic settings such floral enhancements can attract beneficial insects for pollination services, and assist with the control of pest species by providing habitat and resources for predator and parasitoid populations (Long *et al.* 1998).

Figure 3. A floral strip comprised of Cumberland Plain Woodland plant species, established as part of targeted native floral enhancement studies. Photo: Lena Alice Schmidt

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"Healthy bee populations for sustainable pollination in horticulture" is funded by the Hort Frontiers Pollination Fund, part of the Hort Frontiers strategic partnership initiative developed by Hort Innovation, with co-investment from Western Sydney University, Bayer CropScience, Syngenta Asia-Pacific and Greening Australia, and contributions from the Australian Government.

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ANPC workshop reports

Declining Species workshop by Wooragee Landcare

SUE BRUNSKILL
Wooragee Landcare Group, Victoria.

Wooragee Landcare held a Declining Species workshop recently. The group is currently involved in a *Banksia marginata* recovery project which has involved surveying, collecting seeds, cuttings and genetic material and having plants grown for Seed Production Areas on both private and public land. Martin Driver (ANPC) spoke about a vital aspect of working with declining species and that is ensuring sources of seed are available for revegetation. Inadequate seed supplies are one of the blockers for revegetation being carried out at sufficient scale to prevent species decline, and for focusing on particular declining species. A few of us in Wooragee Landcare reflected on the past activities relating to seed banks and seed collection which seemed more active than at present.

Attendees of the Wooragree Landcare Declining Species in the field. Photo: Sue Brunskill

The field trip was to a local farm where the owners Anne and Fleur Stelling have fenced off a paddock of remnant vegetation and removed all stock. For the first few years the paddock was lightly grazed but they have found they have had better recovery when all sheep grazing was removed. Not only have shrubs recovered and regenerated but a wonderful display of herbs and forbs – Blue Pincushion (*Brunonia australis*), Spur Velleia (*Velleia* sp.), *Pimelea* sp., orchids, chocolate lilies and many more.

Image of herbs and forbs regenerating with the Blue Pincushion (*Brunonia australis*) most prominent in the photo. Photo: Sue Brunskill

Landcare groups are in a valuable position to be able to act on species decline – they are not so bound by large strategies and have more flexibility than larger organisations.

It was a very thought provoking session with Martin and has spurred us on to continue thinking (and acting) about seed and seed supply, so we can continue to implement on-ground works to prevent species decline.

Wooragee Landcare gratefully acknowledges Wettenhall Foundation for initial funding, and Maurizio Rossetto (genetic testing) from the Royal Botanic Garden Sydney and ANPC.

ANPC member profile

Introducing the new ANPC President: Tony Auld

At the ANPC Annual General Meeting on 20 November 2019, Dr Tony Auld was elected as the new ANPC President for a two year term. This will involve being the Chairperson of the ANPC Management Committee, managing the office staff on behalf of the Committee, helping set the direction of the organisation and overseeing the coordination of the ANPC Conference in Albury next year. Dr David Coates, as our new Vice President, will be assisting him in this role.

We would like to warmly welcome Tony aboard and recently caught up with him for a chat to find out more about him and his vision for the ANPC going forward.

First of all, welcome aboard Tony.

As a bit of a background for those who don't know you, where do you work and what projects are you working on at the moment?

I am currently a Senior Principal Research Scientist in the Science Division of the NSW Department of Planning, Industry and Environment. I am also a Senior Team Leader for Managing Threats to Biodiversity and am a Professorial Fellow at UNSW and University of Wollongong. Lately, I have been working on a diverse array of things from: risk assessment of threatened plants and ecological communities for listing under state and Commonwealth legislation; application of the IUCN Key Biodiversity Areas concept into NSW legislation as Areas of Outstanding Biodiversity Value; threatened species conservation; impacts of fires on plants; impacts of feral grazers on arid system plant persistence; and impacts of exotic rats on plant populations on Lord Howe Island. I have a particular interest in soil seed banks and the role they play in the resilience of plant species to disturbances such as drought, fire and floods, as well as providing resilience to a range of threats.

How did you end up working in plant conservation? What/who inspired you? I started off at Sydney University doing botany and zoology majors and developed an interest in population biology. Exposure to ideas on how to understand species' responses to disturbances was a highlight of my undergraduate times, plus developing a love of plant ecology. Peter Myerscough was my honours and PhD supervisor and I focussed on how species (particularly *Acacia suaveolens* and *Angophora hispida*) persisted in fire-prone habitats. My ideas on ecology at the time were inspired by people like Peter, Daniel Janzen (US researcher on plant animal interactions), Graeme Caughley (wildlife ecologist), Tony Underwood (marine ecologist) and John Harper (UK plant population biologist) as well as many other colleagues and students.

Tony Auld. Photo: Ewan Auld

I was lucky enough to get a research position in NSW National Parks and Wildlife Service and work with some great conservation biologists over many years, including David Keith (UNSW), Richard Kingsford (UNSW) and Ross Bradstock (UoW). This allowed me to understand how best to implement the science into management and policy.

What are your goals/ where would you like to take the ANPC over the next two years? Increasing the awareness of how a changing climate affects the ability of plant species to persist, combined with stressing the importance of the need to observe and understand the changes occurring and apply the best evidence-based management and policy strategies we have.

How do you see the role of the ANPC in linking science, management, and practitioners, especially those at the community level? ANPC already plays an important role in collating and summarising the evidence base and making it available to a range of users, from the community to all levels of government, non government and scientists. This should continue and be promoted as a key value of ANPC.

What do you see as the ANPC's strengths/ achievements? The ability to collaborate with and involve people from a range of backgrounds and perspectives, all united under the aim of ongoing plant conservation is a highlight. That is combined with the high quality and significance of publications like the latest ANPC Guidelines for the Translocation of Threatened Plants in Australia, APC and the workshops and conferences.

And where do you think there is room for improvement? There is always a challenge in combining education and advice about the long-term conservation of plant species and their habitats in a changing world where people are presented with new and emerging threats both to humans and to nature. ANPC can play an important role in bringing together expert advice on plant conservation issues in the changing times that lie ahead of us.

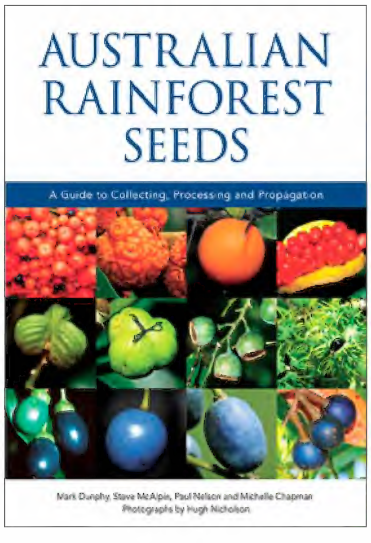
Anything else you would like to mention?

I would like to thank Linda Broadhurst for all her hard work as President over the last 4 years as well as all the executive that supported her.

Book reviews

Australian Rainforest Seeds – A Guide to Collecting, Processing and Propagation

Mark Dunphy, Steve McAlpin, Paul Nelson and Michelle Chapman, photographs by Hugh Nicholson.
216 pp. ISBN: 9781486311507. RRP $49.99



Public interest in cultivating Australian native rainforest trees has been growing steadily for several decades. Often, the biggest challenges for those who seek to successfully raise these trees is obtaining viable seed and getting it to germinate successfully. For many species, there is very little in the way of published information on these topics. This excellent guide addresses this shortfall by providing information on how to collect, process and germinate seeds of 300 subtropical rainforest tree species. The book is the culmination of several decades of practical experience gained by the authors in the nursery industry and their dedication to this subject is evident on every page of the book. Although the book is primarily intended to serve as a reference guide, there are several informative chapters for novices, outlining basic tree morphology and biology, along with the collection, processing and storage of seeds; plus various methods of propagation.

The writing style is clear, concise and accessible to a very broad readership. The layout is both logical and visually pleasing and the photographs are of a consistently high standard throughout. This volume complements the extensive literature on the diversity and identification of Australian rainforest trees and is likely to find its way onto the bookshelves of just about everyone who has an interest in cultivating these plants. Furthermore, horticulturists, botanists, ecologists and anyone engaged in the ecological restoration of rainforest landscapes will benefit from the information that the authors provide.

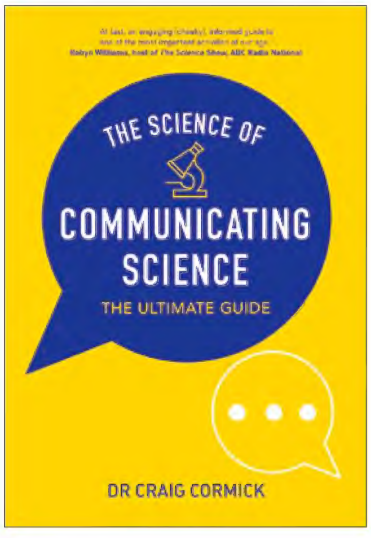
The only apparent shortcoming is the title: "Australian Rainforest Plants" is a catch-all term that encompasses all types of rainforest, from Tasmania to Cape York, yet the 300 species that are discussed are virtually all from northern New South Wales and Southern Queensland. This results in the omission of some tree species and ecological processes that I expected to be covered in some detail. For instance, I was looking forward to reading a section on how to manually process seeds of fruits that are typically eaten by cassowaries, given the importance of these birds to seed dispersal and germination in rainforests in north Queensland, but this is not discussed. The authors have taken the correct approach by limiting the scope of their work to the species they have experience with, but this leads to a conundrum with regards to the wording of the title and I feel that changing it to "Australian Subtropical Rainforest Seeds" would be the best solution.

Australia faces unprecedented environmental challenges, and as we have seen in recent months, even rainforests are at risk from bushfires nowadays. This priceless part of our natural heritage will require enormous efforts to conserve and maintain it in the decades ahead. The need for ecological restoration and replanting of Australian rainforest habitats has increased dramatically in recent years – a trend that appears likely to continue – so this is a book of its time, and one that will be highly valued by those who are engaged in the management of our rainforests.

Reviewer: Charles Clarke, Cairns

The Science of Communicating Science: The Ultimate Guide

Dr Craig Cormick.
CSIRO Publishing, Locked Bag 10, Clayton South, Victoria 3169 (2019). ISBN: 9781486309818. RRP $49.99



As the world of alt facts and confirmation bias becomes more entrenched through the inevitable shift in sources of knowledge, effective communication of scientific outcomes becomes more important. Already many scientists use social media (the author identifies a Twitter bias) and alternative academic media (such as The Conversation) to delve into the communication fray. But using these and other platforms is only half the process. The real trick is using them effectively, so that scientific messages have influence, promote change and don't simply reverberant through existing professional networks and supporters.

In this Ultimate Guide, Cormick does a service to science through charting the various fields, methods and challenges of communicating science. Starting, as a good communicator should with providing context. What is good communication anyway? Why do we need to communicate science? He kindly reminds us (or maybe tells me for the first time) that giving people the "right" information doesn't predicate them making the "right" decisions. That the Deficit Model has never been accurate (Chapter 3). Or facts don't change minds. Feelings do. And that is why it is so important to build trust and relationships, to understand 'audience' motivations before even attempting to introduce something that conflicts with these. Ultimately, he reduces communication to three elements; know your audience, tell a good story and be clear what you want to achieve. And from these three key components that we jump off into the sometimes familiar and sometimes confronting field of science communication.

This book is clearly aimed at one audience. Scientists. A "tribe" (or societal segment, kind of like the LOL Cat videos Tribe [Ch 6], or Power Tribe with which most politicians and lobbyists identify [Ch 15]) into which Cormick includes himself as evidenced by references to "we" and "us"(See Chapter 15 for references to how "we" [scientists] can become a power tribe and communicate more effectively with decision makers and funding bodies). It makes for good reading, knowing the author is part of our group. But I did frequently wonder, what do science journalists get taught about communicating science? What about NRM and Agriculture extension personnel? And how different or similar would this guide be if those groups were part of the audience?

This book contains some of the expected communication tools such as effective storytelling (Chapters 7 and 8) media platforms (Chapter 10), social media use (Chapter 11), framing content specifically to appeal to different audiences (Chapter 12), public speaking (Chapter 13) and evaluation (yes, apparently that doesn't occur often, surprise! [Chapter 16]). But it also deals with some areas I hadn't immediately considered, such as public perceptions of science (Chapter 5), the importance of building and maintaining trust (Chapter 9), understanding different beliefs (Chapter 17), how to navigate science controversies (Chapter 21), fake science news (Chapter 22), can you really change behaviors? (Chapter 20) and why science communication research can be misleading in that most studies focus on the USA, a population that is quite culturally distinct (Chapter 24). Any of these chapters are relevant and useful, depending on the communication intention and the weaknesses and bias of the communicator. For me, Chapter 15 which details the negotiating policy and politics was the most immediately useful, and if no other is essential reading for all scientists. Because let's face it, we all need to navigate policy and politics and the better we do it the higher chance of project longevity and (yes) funding. Cormick reminds us in this chapter that communicating is not just about sharing our research, it is about guiding the future of our respective fields and using appropriate delivery (Chapter 12), to make sure our facts fit within the right "frame" of reference to be impactful. This chapter was unanticipated but fits with the text like that critical corner piece of the jigsaw that drives you mad when it is missing.

Cormick elegantly combines data with narrative, to reinforce a message and to illustrate that a good story (particularly where it is personally relatable) is far more impactful that data (yes, that is supported by research). That humans tend to make decisions based on intuition and direct relatedness (*e.g.*, "I know someone who knows someone that had their child impacted by vaccines") as opposed to abstract figures. But I couldn't help but notice, where are the stories of failure? Examples of projects that didn't work, and if his book is anything to go by, success is really in the minority. Likely this is less to do with Cormick and more to do with our penchant in science for promoting successes, but still, as a species who retains fear-based learnings, a peppering of these "yes, it can turn bad" stories wouldn't go astray.

Part way through this text I began getting a sense that much of the book focused on managing mis-information and how the uncertainty of science lends it to being ripe for controversy. Such that "Science; a marketing guide", might also have been an applicable title. It was clear that science, for the majority, is only one small component to be considered in a decision-making process and our challenge as scientists is – how to present the package so it sells in an ever-shifting market. But then I read Chapter 23 Fantastic Ethics and where to find them – which delineates how Science Communication is different from marketing and journalism. I do wish the definition of Science Communication, as distinct from communicated science, had occurred in the early chapters.

Overall, this was a surprisingly enjoyable read. Different from slogging through an academic text, and in the weeks post-reading I have continued to reference its core tenant, that a person's values and beliefs are very, very difficult to realign, as they form part of self-identity. And, when challenged directly, will more likely result in a strengthening and reaffirmation, rather than consideration of plausible alternatives. Most chapters, at some point address the idea that challenging pre-existing perceptions with data and facts is ineffectual (at least in the first instance) and that effective communication really relies on some degree of empathy – acknowledging different pre-existing world views and framing discussions so that they align with this perception (*e.g.,* Chapter 22 and Chapter 17). What was also refreshing was Cormick's statement that, scientists too are guilty of cherry-picking studies that reaffirm personal beliefs (*e.g.,* support or rebuffing of GMO technology) and that a diversity of beliefs is societally good- provided these beliefs are not hurtful or detrimental to ourselves, our environment or other lifeforms.

Does this book deliver as promised on the cover; The science of science communication? If you mean references to peer reviewed studies supporting underlying theme and statements- then yes. If you mean a repeatable, comparable method for reliably communicating- in line with scientific method- then no. But then remember, part of the trick to communicating, is to present messages in a frame (or context) that the audience will accommodate. And in that way, potential readers have been framed.

Is this guide worth reading? Yes. Not just as a quick skim (although it works for that too) but also the compartmentalised sections lend it as a reference to be considered before designing communication (yes, it should be designed from the outset). And that, is the point. Communication should be planned, for the audience and for the communicator. Because to paraphrase Cormick, there is no point being in an evidence based tribe who can see the problems, but doesn't have the power to do anything about it.

Reviewer: Chantelle Doyle. Consultant, AMBS, PhD Candidate UNSW and co-host of science radio show, Boiling Point

News and conferences

ANPC News

ANPC Annual General Meeting held 20 November 2019

The Annual General Meeting of the Australian Network for Plant Conservation Inc. (ANPC) was held on Wednesday 20 November 2019 at the Australian National Botanic Gardens, Canberra. Thank you to all those who attended and/or nominated for Management Committee positions. Dr Tony Auld was nominated as President, and Dr David Coates as Vice-President. Dr Stephen Bell, Dr Andrew Crawford, Dr Paul Gibson-Roy, Dr Lydia Guja and Bob Makinson were nominated as Ordinary Members. Welcome to new committee members Tony, Stephen and Lydia. And many thanks to Dr Kate Brown, Selga Harrington, Chris Ikin, Maria Matthes and Kylie Moritz who stepped down from the committee this year (previous President Linda Broadhurst was recently nominated as an Ordinary Member after the AGM).
https://www.anpc.asn.au/committee/
Read the President's Report on what the ANPC has achieved over 2019 here
https://www.anpc.asn.au/wp-content/uploads/2019/11/ANPC_Presidents_Report_for_2019_AGM.pdf

Newly elected ANPC President, Dr Tony Auld.

ANPC's '*Plant Germplasm Conservation in Australia*' guidelines to be reviewed over next 2 years!

The ANPC is extremely excited to announce that we have received an Environment and Conservation grant from The Ian Potter Foundation to review and update the ANPC's Germplasm Guidelines. Called '*Conserving our national plant treasures: guidelines for collecting, storing and growing Australian plants for restoration*', this project will fund the comprehensive update of one of our flagship publications.

The Germplasm Guidelines are the definitive Australian standard for native seed and regenerative plant material collection, storage and use, last being published in 2009. Since that time, seed biology research has progressed significantly and to ensure that the latest information is passed onto practitioners and land managers, we will bring together leading experts in seed biology research and practice from across Australia to review and rewrite the Guidelines. The project will incorporate updated scientific knowledge to ensure Australia's seed sector maintains the necessary skills and knowledge required.
https://www.anpc.asn.au/germplasm-guidelines-review/

Healthy Seeds project update

The Healthy Seeds Consortium of partners from across the native seed and ecological restoration sectors has been established between the ANPC and the Centre for Australian National Biodiversity Research, Royal Botanic Gardens Sydney, Department of Planning, Industry and Environment, Australian Seed Bank Partnership, Greening Australia, Australian Association of Bush Regenerators and the Society for Ecological Restoration Australasia, to oversee the project and has held its first meeting. Martin Driver and Lucy Commander commenced in September as the Healthy Seeds Project Manager and Florabank Guidelines Project Manager respectively, and have hit the ground running. And Murray Local Land Services has started the audit and investigation into past and present Seed Production Areas (SPAs) in NSW. SPAs are seen as central to overcoming shortfalls in high quality native seed for ecological restoration, and for improving seed supply reliability, reducing pressure on wild populations, and for improving genetic provenance and diversity to ensure the long-term health and resilience of restored ecosystems.
https://www.anpc.asn.au/healthy-seeds/

Invasive fungus myrtle rust is pushing Australia's native trees toward extinction

While cane toads creep across northern Australia and down the eastern coastline, a far more insidious invasive species is ravaging our native trees. Scientists warn rapid extinctions of some of our most well-known tree species are on the cards if myrtle rust, an invasive, disease-causing fungus, is not rapidly brought under control. Myrtle rust, or *Austropuccinia psidii*, has caused extensive dieback of trees including lilly pillies, paperbarks, box brush and tea trees. The areas most affected are wet forest environments, such as coastal heath, paperbark wetlands and rainforests, along the east coast of Australia, said Bob Makinson, a conservation botanist with the Australian Network of Plant Conservation. "We know that at least four species are in what can only be termed catastrophic decline," Mr Makinson said. "The critical endangered status that's been afforded to three of those species in New South Wales means that they are in danger of extinction in the near future.
https://www.abc.net.au/news/science/2019-12-04/myrtle-rust-fungus-invasive-species-killing-native-trees/11730738

Exclusive to ANPC members, a gift membership form is available with a 10% discount!

Need a present for someone who cares about our native plants? Just complete our Gift Membership Form and email it to anpc@anpc.asn.au. They will receive four editions of *Australasian Plant Conservation* per calendar year as well as discounts to our workshops and conferences. You can also elect for them to receive the FREE e-version of *Plant Germplasm Conservation in Australia* and/or subscribe to *Ecological Management and Restoration*! Your gift will help contribute to plant conservation in Australia. We couldn't achieve all we do without our members!
https://www.anpc.asn.au/membership/

Australasian Seed Science Conference - Canberra ACT, new dates 5-9 September 2021

As a result of the ongoing impact of the COVID-19 virus, the Australasian Seed Science Conference was postponed. The Organising and Scientific Committees are pleased to announce that the Conference will now be held from 5-9 September 2021, and would like to extend their appreciation to those who have contributed abstracts and time to developing the conference program. For more updated information please visit the Conference website and join our mailing list to keep up-to-date with new developments.

ASSC2021 will be covering the following themes: Seed biology and evolutionary ecology – Unlocking the challenges of germination, dormancy and seed ecology in a changing world; Seed sourcing and end-use – Considering genetic diversity, restoration and translocations as well as sector specific approaches to seed conservation and use; Seed and gene bank management – The ins and outs of managing *ex situ* seed banks and gene banks and the methods for maximising seed quality and longevity; Seeds in culture and society – Sharing stories and learning about cultural seed use, including collaborations between traditional use and *ex situ* seed banks and gene banks.

https://seedscience2021.com.au/

SPECIAL SECTION – ANPC response to bushfires

MESSAGE FROM ANPC PRESIDENT DR TONY AULD

In addition to the enormous human, social, economic and native animal impacts of the recent catastrophic bushfires, the impacts on our unique plants and ecological communities will also be huge. Although most Australian flora have evolved to cope with fire, recovering by re-sprouting or seed germination, the drought combined with severe and too frequent fire will retard recovery. Some plants and ecological communities that have been burnt, including many rainforest species, are sensitive to fire and may struggle to recover. At this stage, while many threatened plants have had populations that were burnt, we don't know how well they will recover. Encouraging some native flora to bounce back will require targeted funding and actions to conserve and restore habitats and ecological communities, including control of weeds and feral grazers, and ensuring we have or develop *ex situ* seed banking for as many threatened species as possible. Resilience of many native plants will depend on allowing them enough time to replenish their natural seed banks. We will also need comprehensive monitoring of fire affected landscapes, starting immediately and continuing from after the first rains, for up to two years, to detect which species are returning, and which are not.

The current fires are unprecedented in extent and severity and have burnt over many areas where the plants had not yet recovered from previous fires. In these cases, assessing natural plant recovery may identify the need for cautious and well-planned human intervention. Areas/species likely to require assistance include threatened species, particularly those known from only one or to populations. In these cases, assessing the natural plant recovery, as well as assessing risks to recovery (grazers and weeds) will inform the development of a restoration plan, and identify which native species are not returning. The ANPC's *Guidelines for the Translocation of Threatened Plants in Australia* will be useful for planning recovery of threatened plants. Post-fire seed collection should be minimal to allow species to replenish natural seed banks. Once that has happened, any seed collection, storage, propagation and planting should follow the ANPC's *Plant Germplasm Conservation in Australia* and the soon to be re-released *FloraBank Guidelines*.

Below, we provide some information and links on what you can do to help post-fire recovery of plants and ecological communities, and how you can start sharing your knowledge on post-fire responses. We also provide links to a couple of media items we have published recently, as well as many other bushfire related articles. Hopefully, we can all work together at this difficult time to conserve our plant biodiversity and be better prepared for plant recovery into the future.

In addition, here's some ANPC Plants and Fire fact sheets I have put together:

How plants cope with fire
https://www.anpc.asn.au/wp-content/uploads/2020/01/Auld_Fire-and-plants_how-they-recover_-PDFv1a.pdf

What is Fire? Fire and its components
https://www.anpc.asn.au/wp-content/uploads/2020/01/Auld_fire-regimes_What-is-Fire-revised-PDFv1a.pdf

What we can do to help post-fire recovery of plants and ecological communities

The ANPC is putting together some resource pages on plants and fire after the devastating 2019/20 Australian bushfires. Read about what governments are doing, find other related links, and articles from the media and APC. Find out how plants and ecological communities recover from fire and what we can all do to help, including not dumping garden waste in burnt areas like the photo below. Please share with your colleagues, neighbours and friends who may be in fire-affected areas. Help us get the word out there! Weeds are one of the biggest threats to plant recovery at this time.
https://www.anpc.asn.au/plants-and-fire-2020/ and https://www.anpc.asn.au/bushfire-2019-2020-resource-page-2/

- **Stay out** of recently burnt areas until it is safe – trees and branches may continue to fall for days, weeks and months after the fire has passed.
- **When it's safe** to go in the bush, **assess** the site. Keep to formed tracks and do not walk in areas where plants are regrowing and seedlings emerging as this can damage their recovery and lead to soil erosion.
- In the short, medium and long term, carefully **assess** biodiversity loss and **natural plant recovery** after the fires, as some species may disappear, but many have mechanisms to cope with fire. Use standardised monitoring techniques so different sites can be compared.
- Identify **threats** to plant recovery such as weeds, grazers and disease.
- Use the assessment results to **develop a restoration plan**. Implement your plan, keep good records about what you do, monitor your site to determine the effectiveness of any restoration actions.
- Prioritise **assisted natural regeneration actions** where necessary within burnt bushland, and at its edges and in unburnt refugia, to control feral predators, herbivores and invasive plants. Planting is rarely needed.
- Work with **others** – join a local bushcare volunteer group, call your local council or local land/catchment management group, collaborate with your local university, join local and national networks.
- **Learn, communicate**. Attending training courses, talk to others in your area, read books, apply for funding if you need assistance. Share your information with others.
- Continue to **protect burnt areas**, as they need time to recover, and **unburnt areas too**, as these may act as refuges for biodiversity – from which species can repopulate burnt areas.
- Don't plant or seed into burnt and naturally regenerating areas in the period immediately after the fire – wait to see what regenerates in the medium to long term and seek expert advice, before deciding what interventions are needed.
- Don't collect seeds in burnt areas
- Don't take too much seed from unburnt areas.
- Don't clear "dead" plants which may resprout and provide shelter for remaining wildlife.
- Don't dump garden waste or other organic material in the burnt areas. This can do more harm than good

Post-fire weed dumping at Wallabi Point NSW, Jan 2020. Photo: Jo Lynch

Call for articles on plants and fire to be published in *Australasian Plant Conservation* in 2020

Following the bushfires affecting large parts of Australia in 2019 and 2020, APC is seeking articles describing plant and ecological communities responses to fire (*e.g.,* fire-triggered seed germination, re-sprouting, structural and floristic community changes) and, where applicable, the impact of multiple fires and differing fire intensities, frequencies or seasons on plants and ecological communities. First deadline is 1 May and the second 1 August 2020. **https://www.anpc.asn.au/apc/**

Hydrocotyle **sp. regenerating from seed after fire. Photo: Heidi Zimmer**

Yes, native plants can flourish after bushfire. But there's only so much hardship they can take

ANPC Project Manager Lucy Commander and APC Editor Heidi Zimmer on restoration following bushfires. In a fire-blackened landscape, signs of life are everywhere. A riot of red and green leaves erupt from an otherwise dead-looking tree trunk, and the beginnings of wildflowers and grasses peek from the crunchy charcoal below. Much Australian flora has evolved to cope with fire, recovering by re-sprouting or setting seed. However, some plants are sensitive to fire, especially when fires are frequent or intense, and these species need our help to recover. Encouraging native flora to bounce back from these unprecedented fires requires targeted funding and actions to conserve and restore plants and ecological communities, including seed banking. **https://theconversation.com/yes-native-plants-can-flourish-after-bushfire-but-theres-only-so-much-hardship-they-can-take-129748**

Some species are able to resprout from blackened stems following a fire. Photo: Lucy Commander

After the fire: can our plants bounce back?

Green shoots can already be seen among the black scorched earth, but experts are cautious about just how well Australia's landscapes will regenerate after the fires that have ripped through millions of hectares across the country. There is also division on what humans could or should do to assist ecosystems as they recover in a period of drought and climate change. Fire is not always a negative for Australia's landscapes...But the strain put on many areas of Australia's ecosystems by prolonged drought, and repeated fires, mean experts say just how parts of the bush will regenerate are yet to be seen....Action also needs to be taken to prevent invasive plants and feral animals like rabbits, goats and horses from impeding recovery, says Lucy Commander, project manager at the Australian Network for Plant Conservation. Dr Commander has also called for the government's $50 million fund for wildlife and plant recovery to be spent strategically, instead of rushing in. **https://www.canberratimes.com.au/story/6586308/after-the-fire-can-our-plants-bounce-back/**

Can Aussie plants really recover from bushfire?

ANPC Committee member Chantelle Doyle chats with plant and bushfire ecologist Dr Mark Ooi about what's normal, what's needed and what kills plants at a time when climate appears out of control **https://eastsidefm.org/podcast/can-aussie-plants-really-recover-from-bushfire/**

Cuttings: Plant news from around Australia

Editors' note: Cuttings news excerpts are clipped from a diversity of sources. To read the articles in full follow the links attached to each clipping. The views expressed in these articles are those of their authors and do not necessarily represent the opinion of the ANPC.

2020 - International Year of Plant Health (IYPH)

In December 2018, the United Nations General Assembly declared 2020 as the International Year of Plant Health (IYPH). The year is a once in a lifetime opportunity to raise global awareness on how protecting plant health can help end hunger, reduce poverty, protect the environment, and boost economic development. Plant pests are one of the main drivers of biodiversity loss. **https://www.ippc.int/en/iyph/** .

ACT Woodland Strategy released

The ACT's woodlands are exceptional in terms of their size, connectivity, diversity and habitat for threatened species. The 2019 ACT Native Woodland Conservation Strategy will guide the protection, restoration and management of our precious lowland and subalpine woodlands for the next 10 years. Its associated action plans for five threatened species (including three plants Canberra Spider Orchid (Caladenia actensis), Small Purple Pea (Swainsona recta) and Tarengo Leek Orchid (Prasophyllum petilum) will guide their preservation. **https://www.environment.act.gov.au/cpr/conservation_and_ecological_communities/lowland_woodlands/woodlands_strategy**

What's in a (plant) name?

Nearly 7000 new Australian plant species have been described in the last 50 years and plant names are invaluable tools for understanding the diversity of life. Keep reading below to learn about plant taxonomy and the classification of a new sedge genus. Plant taxonomy is the science that finds, identifies, describes, classifies, and names plants. Evolutionary biologist Professor Stephen Hopper considers every plant name to represent a hypothesis on plant relationships. This hypothesis is tested every time someone tries to identify a plant, which makes the field of scientific classification one of the most rigorously tested of all scientific fields. **https://www.rbgsyd.nsw.gov.au/Stories/2019/what-is-in-a-plant-name**

Contemporary and traditional fire management approaches in the desert

Landscape-scale fire management in arid areas is challenging because of the vast areas involved. Interest in using techniques like aerial incendiary for fire management in deserts is growing, but it is unclear whether this approach will deliver the same cultural practice, fire and biodiversity outcomes, as traditional, very fine-scale burning carried out from the ground. This project aims to establish a monitoring program to measure the effectiveness of different approaches to fire management over a large Indigenous Protected Area in north-western Western Australia. The project aims to support the transmission of traditional ecological knowledge and will include a range of indicators of conservation and cultural significance. **http://www.nespthreatenedspecies.edu.au/projects/contemporary-and-traditional-fire-management-approaches-in-the-desert**

This vineyard is embracing the Aussie bush by letting native grasses thrive

This vineyard is embracing the Aussie bush by letting native grasses thrive which attract native wasps to help with pest control and reducing the need for the use of chemicals. **https://www.abc.net.au/news/2019-10-31/11657870**

Land clearing near Murray River and national park raises ecologist fears for native habitat

Ecologists say land clearing near a national park, where the NSW Government is trying to re-establish the first native bilby population in 100 years, shows the state's approach to land management does not do enough to protect native habitat. Mallee scrub has been cleared on a property at Trentham Cliffs, across the Murray River from Mildura. Land clearing in the state's far west has raised concerns for ecologists, who said vast tracts of native vegetation are being removed during a period of severe drought. **https://www.abc.net.au/news/2019-10-25/fears-for-native-habitat-as-mallee-cliffs-land-cleared/11623286**

Our nature laws are being overhauled. Here are 7 things we must fix

Environment Minister Sussan Ley yesterday announced a ten-yearly review of Australia's national environmental laws. It could not come at a more critical time, as the environment struggles under unprecedented development pressures, climate change impacts and a crippling drought. The laws, formally known as the Environmental Protection and Biodiversity Conservation (EPBC) Act, have been in place for 20 years. Announcing the review, Ley said it would "tackle green tape" and reduce delays in project approvals. She said the laws must remain "fit for purpose" as our environment changes. Serious declines in most biodiversity indicators strongly suggest the laws are not fit for purpose. Some 7.7 million hectares of endangered species habitat has been destroyed since the Act was established and the lists of threatened and endangered species continue to grow.
https://theconversation.com/our-nature-laws-are-being-overhauled-here-are-7-things-we-must-fix-126021

The Hills are Alive

Millie travels to Kosciusko National Park which is a plant-lovers' paradise in summer. At 2,228m high, Kosciusko may not seem like a big mountain on a global scale, but this Great Dividing Range is one of the oldest in the world. The oldest rocks have been dated over 500 million years old, but the real action started with the break-up of the supercontinent Gondwana. It's an area where the plants and wildlife have evolved over millions of years to cope with the changing landscape and weather, and many of the plants growing here are found nowhere else in the world.
https://www.abc.net.au/gardening/factsheets/the-hills-are-alive/11685858

'Sea asparagus' shows commercial bush food potential for salty inland farmland

A Western Australian farmer believes a native succulent is the secret to creating economic return from salty land where very little else can survive. David Thompson of Katanning, 300 kilometres south east of Perth, said the tasty samphire plant — also known as sea asparagus — thrives on otherwise non-arable country. "It's adapted to growing in a toxic environment," he said. According to the WA Department of Agriculture and Food, samphire plants have a high tolerance to both waterlogged and saline soils. Once established, along saline land, the samphire will spread rapidly if protected from grazing pressure.
https://www.abc.net.au/news/2019-10-31/samphire-bush-food/11653700

Immediate end to old-growth logging, as thousands of jobs set to go

Premier Daniel Andrews says thousands of workers in the timber industry face a "tough transition" as the state government moved on Thursday to end logging of Victoria's native forests. The cutting down of old-growth forest will end immediately, the Premier said in Gippsland on Thursday, and native timber harvesting will be "phased down" before ending completely in 2030. Existing timber supply agreements with dozens of timber mills will be extended to 2024 and after that, wood processors will have to bid for a reduced supply of timber, with a $120 million support package for businesses which leave the industry and workers who lose their jobs.
https://www.smh.com.au/politics/victoria/immediate-end-to-old-growth-logging-as-thousands-of-jobs-set-to-go-20191107-p5388w.html

Wild Orchid Project pollinator surveys

Staff from Royal Botanic Gardens Victoria have been out undertaking pollinator surveys at a crown land reserve and TSR near Oaklands and Urana this week. These sites are being surveyed for blue banded bees (*Amegilla* sp.), the key pollinator of the threatened Oaklands Diuris Orchid (*Diuris callitrophilla*). To survey for pollinators a pot of flowering Diuris orchid is placed near a wild chocolate lily in front of a motion activated camera (in pine sapling) and a video camera (on tripod). Cameras roll for 30 minutes and then the potted orchid and cameras are moved to a new location within the site and the process repeated. Photos and video are reviewed afterwards to check for pollinator activity.
https://www.facebook.com/Murray.LLS/photos/a.245121532261182/2240417386064910/?type=3&theater

Australia's Strategy for Nature

On 8 November 2019, Australian, State and Territory Environment Ministers endorsed a new approach to biodiversity conservation through the Australia's Strategy for Nature 2019-2030. The Strategy is supported by a dedicated website, Australia's Nature Hub. Both the Strategy and the Hub are developed and owned by the Commonwealth, all state and territory governments and the Australian Local Government Association. Australia's Strategy for Nature and supporting website, Australia's Nature Hub, bring together existing work across the country with the aim to guide the development of new and innovative approaches to biodiversity conservation. It focuses on overarching goals that support healthy and functioning biological systems by promoting a stronger connection between people and nature, improving the way we care for nature, and building and sharing knowledge.
http://www.environment.gov.au/biodiversity/conservation/strategy

Cracking the Nut

The land around Brisbane, like much of coastal Australia, has been heavily cleared and developed over the past few hundred years – and one of the casualties is the trees that produce our best-know food export, the macadamia nut. Now grown all over the world, the nuts are native to Queensland and northern NSW, but more than 80% of bush macadamia trees have been lost and they are now threatened in the wild. Jerry goes hunting with scientist Liz Gould, from Healthy Land and Water, to see what specimens they can find. Some still exist in remnant bushland around suburban Brisbane but others are limited to botanic gardens. Macadamias are a member of the Proteaceae family, so are related to grevilleas and banksias. The nuts were traded up and down the east coast by the first nations peoples of Australia.
https://www.abc.net.au/gardening/factsheets/cracking-the-nut/11708364

How Victoria's 'Snow in the Paddocks' melted away - and is being saved

There is a dizzyingly beautiful orchid that grows naturally at only one place on the planet, in a secret patch not far from the centre of Melbourne. It is a delicious white bloom brushed with purple and yellow highlights. Thirty-seven wild plants survive at an industrial site too hazardous to be trampled at random, simultaneously rescued and marooned. Once they were common, splashed horizon to horizon across the grasslands that would become the western suburbs of Melbourne. The orchid's tuber was a favourite Indigenous food, the equivalent of a root vegetable. Indigenous people farmed it with fire. A cool burn at the right time would remove competing vegetation, open the ground to sunlight and spread a layer of nutritious ash.
https://www.smh.com.au/environment/conservation/how-victoria-s-snow-in-the-paddocks-melted-away-and-is-being-saved-20191104-p5379a.html

What is a 'mass extinction' and are we in one now?

For more than 3.5 billion years, living organisms have thrived, multiplied and diversified to occupy every ecosystem on Earth. The flip side to this explosion of new species is that species extinctions have also always been part of the evolutionary life cycle. But these two processes are not always in step. When the loss of species rapidly outpaces the formation of new species, this balance can be tipped enough to elicit what are known as "mass extinction" events. A mass extinction is usually defined as a loss of about three quarters of all species in existence across the entire Earth over a "short" geological period of time. Given the vast amount of time since life first evolved on the planet, "short" is defined as anything less than 2.8 million years. Since at least the Cambrian period that began around 540 million years ago when the diversity of life first exploded into a vast array of forms, only five extinction events have definitively met these mass-extinction criteria.
https://theconversation.com/wh

Coleus genus resurrected

The genus Plectranthus has recently lost 62 Australian species. But don't worry, they haven't gone extinct. All Australian Plectranthus species have been transferred to the recently resurrected genus Coleus. Plectranthus has been known as a widely used horticultural and medicinal plant genus of herbaceous or succulent shrubs belonging to the economically important mint family Lamiaceae. But don't let the association with mint fool you. While some have a pleasant minty scent, others give off a much more pungent odour when crushed. Until now, there have been about 350 species in the Plectranthus genus which is mostly distributed in the Southern Hemisphere from sub-Saharan Africa, Madagascar, India and the Indonesian archipelago down to Australia and some Pacific Islands.
https://www.rbgsyd.nsw.gov.au/Stories/2019/Coleus-back-in-the-name-game?fbclid=IwAR3aMQzdg9HlZgtg0doXQ4U5WoiY_yhWiMXnFbYI5UT6pDzVK4RAAbVwwFg#.Xc8IVLIA8F4.facebook

Hawkweed Hounds

Up in Australia's alpine and sub-alpine areas, the plants are adapted to the tough climate. They can cope with dry summers, cold wet winters and strong winds. Some are designed to hitch a lift on animals – or socks! – to spread their seed, such as bidgee-widgee (Acaena novae-zelandiae). However other weedy plants spread this way too and some of them pose a real threat to this fragile environment. Millie meets up with Mark Hamilton, a weed ecologist with the NSW National Parks and Wildlife Service, who is on a mission to hunt down one of the most invasive weeds to have been found in Australia's alpine areas – hawkweed.
https://www.abc.net.au/gardening/factsheets/hawkweed-hounds/11709068?fbclid=IwAR1uivm_RxbJctMcc0c75SL2V6XiF9bxvBvtFNx6Z-EXGPXvXTJjjrY_61I

Govt gives boost to native veg

The state government has announced a multi-million-dollar commitment to expand funding for holders of native vegetation Heritage Agreements, which has been welcomed by farming and environment groups. Improving native vegetation on private land protects and enhances biodiversity, improves landscape sustainability through enhanced water and soil condition as well as offering additional tourism potential, said Environment Minister David Speirs. "To boost the benefits of improved native vegetation across SA, the state government has committed $3 million of funding over the next two financial years," he said.
https://www.stockjournal.com.au/story/6497118/govt-gives-boost-to-native-veg/?cs=4894&fbclid=IwAR0zu-BtFWyq1p-z0fV5pRfisggKXdG1klMmqxKuxS_xt2Mpks-UM8I37y4

Our land is burning, and western science does not have all the answers

Last week's catastrophic fires on Australia's east coast – and warnings of more soon to come – will become all too common as climate change gathers pace. And as the challenges of modern hazard reduction become clear, there is much to learn from the ancient Aboriginal practice of burning country. Indigenous people learnt to use fire skillfully and to their advantage, including to moderate bushfires. Most of the fires were small and set at dry times of the year, resulting in a fine-scale mosaic of different vegetation types and fuel ages. This made intense bushfires uncommon and made plant and animal foods more abundant. Contemporary fire managers also attempt to lower bushfire risk by reducing fuel loads through hazard reduction burning. To minimise costs, this is often achieved by dropping incendiaries from aircraft. Concern is growing that such methods exacerbate biodiversity declines and often do not prevent a subsequent bushfire. As climate change makes bushfires more ferocious and extreme, now is the time to better understand how our First Peoples used fire.
https://theconversation.com/our-land-is-burning-and-western-science-does-not-have-all-the-answers-100331

South Pacific Heathland Reserve in Ulladulla sees flowers flourish after fire

A heathland reserve on the New South Wales south coast has come back to life after being scorched by bushfire in August 2018, and local land carers are praising the role of fire in maintaining the environment's biodiversity. The South Pacific Heathland Reserve near the seaside town of Ulladulla is 14 hectares set within a cliff line and a suburb, with an extraordinary amount of plant diversity in a relatively small area. The landscape, which has been nurtured by volunteers since the 1960s, is made up of several vegetation types including wet heathland, sand heath, and coastal woodland. In August last year the area was s*et al.*ight by arsonists.
https://www.abc.net.au/news/2019-11-22/healthland-volunteers-say-fire-needed-for-flora-health/11716804

World heritage Queensland rainforest burned for 10 days – and almost no one noticed

A year ago, a black scar appeared on the far north Queensland landscape. Satellite images and photographs show the aftermath of a bushfire that burned in world heritage tropical rainforest for 10 days. Almost no one noticed when the Japoon national park caught fire – mature rainforest trees destroyed across about 250 hectares. A single story in a local newspaper, focusing on how the fire started, appears to be the only time it has been reported. Experts and rainforest authorities say the remarkable extent of the damage, across an environment supposed to naturally suppress fires, is among the clearest evidence that climate change has shifted the paradigm in the tropics.
https://www.theguardian.com/australia-news/2019/nov/24/world-heritage-queensland-rainforest-burned-for-10-days-and-almost-no-one-noticed

Green groups fear Victorian logging ban may actually endanger some old growth forest

Environment groups have raised doubts about the Victorian government's promise to protect 90,000 hectares of old growth forest, just weeks after the Andrews government announced a major transition plan for Victoria's timber industry. Six organisations, including The Wilderness Society, Friends of the Earth and Environment Victoria, have expressed fears that the government will open up some areas currently mapped as old growth to logging. In a letter to the premier, Daniel Andrews, and the environment minister, Lily D'Ambrosio, the groups have called on the government to clarify how it plans to implement its promises, which include an immediate ban on old growth logging.
https://www.theguardian.com/environment/2019/nov/26/green-groups-fear-victorian-logging-ban-may-actually-endanger-some-old-growth-forest

Bushfires devastate rare and enchanting wildlife as 'permanently wet' forests burn for first time

The rainforests along the spine of the Great Dividing Range, between the Hunter River and southern Queensland, are remnants of Gondwana, the ancient supercontinent that broke up about 180 million years ago. "Listening to the dawn chorus in these forests is literally an acoustic window back in time," ecologist Mark Graham tells RN's Saturday Extra. "It's like listening to what the world sounded like in the time of the dinosaurs." The forests are mountaintop islands that have been "permanently wet" for tens of millions of years. But now, these forests are being burnt for the first time.
https://www.abc.net.au/news/2019-11-27/bushfires-devastate-ancient-forests-and-rare-wildlife/11733956

Bushfire-ravaged community embrace blooming wildflowers as symbol of hope

As the smell of smoke still lingers amid the blackened earth in New South Wales' bushfire-ravaged communities, the emergence of new growth has sparked much needed joy for residents. A Rural Fire Service crew recently spotted the bright splash of colour of a Christmas bell blooming near Lake Cathie, south of Port Macquarie. A fire which burned for more than two weeks in the area destroyed more than 3,500 hectares and may be responsible for the deaths of hundreds of koalas. The community has embraced the red and yellow bloom against the backdrop of scorched earth as a symbol of hope and new life.
https://www.abc.net.au/news/2019-11-27/wildflower-amid-bushfire-devastation-is-a-symbol-of-hope/11738442

I Spy A Wollemi Pine

Do you know of a Wollemi Pine growing in a park or garden? Whether it's in your backyard, outside your office window, or in a nearby public space ... We want to hear from you! Using citizen science, researchers at the Australian Botanic Garden want to investigate where exactly Wollemi Pines are growing in gardens across Australia, and worldwide. Why? Identifying the hottest, coldest, wettest and driest places where Wollemi Pines are grown will give us important insight into the environmental tolerances of this special tree, which will in turn help us manage it in a changing climate. We hope that this citizen science project will also raise awareness of the importance of gardens in threatened plant conservation. Undertake the survey here
https://www.surveymonkey.com/r/wollemi?fbclid=IwAR0blOGEUzC2wQYfZJn-h2OfVjlFpEFbnbrKh7zxr7wAPvoHIhTWSHTXshk

Missing in action: our new biodiversity strategy

Australia's new ten-year biodiversity strategy is a huge disappointment for invasive species and for biodiversity in general. While the strategy sets out the broad goals of government and how progress will be measured, it fails to define what progress looks like or how it will get there. For addressing invasive species, the greatest threat to Australia's plants and animals alongside habitat loss and climate change, this approach will perpetuate the lack of focus that has hampered progress over the last decade. On 8 November 2019, national, state and territory environment ministers endorsed a new biodiversity strategy for Australia. This strategy covers the period 2019-2030, replacing Australia's Biodiversity Conservation Strategy 2010-30.
https://invasives.org.au/blog/missing-in-action/

Buffel-busting duo turn controversial grass into beautiful ceramics

Some hate it, some love it, some make pottery glaze out of it. Buffel grass has its uses, depending on who you talk to and where you live. For Northern Territory pastoralists, it's a good stock feed and an effective dust suppressant, to others, it is a nuisance that needs to be eradicated, particularly in South Australia where it is a declared weed. Either way, there is a lot of the introduced grass covering central Australia and beyond. Ceramicists Suzi Lyon and Mel Robson volunteer for the Alice Springs Landcare 'Buffel Bust' programs, which run between March and October to help control the grass across six areas to help protect remnant trees and encourage new growth.
https://www.abc.net.au/news/2019-12-01/buffel-busting-duo-turn-controversial-grass-into-ceramics/11730114

Scientists re-counted Australia's extinct species, and the result is devastating

It's well established that unsustainable human activity is damaging the health of the planet. The way we use Earth threatens our future and that of many animals and plants. Species extinction is an inevitable end point. It's important that the loss of Australian nature be quantified accurately. To date, putting an exact figure on the number of extinct species has been challenging. But in the most comprehensive assessment of its kind, our research has confirmed that 100 endemic Australian species living in 1788 are now validly listed as extinct. Alarmingly, this tally confirms that the number of extinct Australian species is much higher than previously thought.
https://theconversation.com/scientists-re-counted-australias-extinct-species-and-the-result-is-devastating-127611

'Dinosaur tree' Wollemi pines safe for now as Blue Mountains bushfires continue to burn

The original wild specimens of the ancient Wollemi pine tree are safe for now as fires which have burnt more than 220,000 hectares continue throughout the Blue Mountains region of New South Wales. The National Parks Wildlife Service "has measures in place to protect the Wollemi pines from fire and they are okay," a spokesperson from the Department of Planning, Industry and Environment told the ABC. However, the department also noted the trees' survival "depends very much on their location remaining secret".
https://www.abc.net.au/news/2019-12-05/wollemi-pine-trees-national-park-fires-blue-mountains/11763420

Ancient bunya trees in Queensland are dying from an invasive soil-borne disease

The towering ancient bunya pine is known for its enormous cones and edible nuts, which make it central to a rich Indigenous heritage of meeting, feasting and trade. But in the pine's home in southern Queensland's Bunya Mountains, an unprecedented dieback of the ancient trees has scientists and rangers worried. It's believed an exotic soil-borne fungal-like organism called phytophthora has caused the death of around 50 bunyas, and there are concerns that the spread could continue. Some of the dead trees are thought to be between 600 and 800 years old, and would normally live for more than 1000 years according to Louise Shuey, a plant pathologist with the Queensland Department of Agriculture and Fisheries.
https://www.abc.net.au/news/science/2019-12-10/anciet-bunya-pines-dying-from-plant-disease/11766594?section=science

Almost a quarter of eucalypt trees found to be threatened with extinction

Some 134 species of eucalypts had drops in numbers of at least 30% and the endangered Rose Mallee declined by more than half. A global assessment of all 826 known species of eucalypt trees – of which some 812 grow only in Australia – has found almost a quarter are threatened with extinction. The figures are revealed in the International Union for Conservation of Nature's update of its "red list" of threatened species. Eucalypts in their native range of Australia faced threats from human land use, especially agriculture and urbanisation, the IUCN said.
https://www.theguardian.com/environment/2019/dec/11/almost-a-quarter-of-eucalypt-trees-found-to-be-threatened-with-extinction

Julie Radford is Victoria's 'orchid whisperer', propagating rare native orchids one tiny seed at a time

Dedicated ecologist, Julie Radford, has worked for the last 12 years to propagate rare native orchids to help bring them back from extinction. But her first experience with orchids was not an entirely positive one. "I just bought this orchid when my children were really little, and I didn't know anything about caring for orchids," she said. "I worked on trying to keep this thing alive for years, and I actually threw it in the bin three times. "I had a young daughter at the time, and she kept getting it out of the bin and saying, 'You can't do that. It's not dead yet'." Julie's daughter's affection for the plant got Ms Radford wondering whether there were any native varieties growing in the Victorian bush, where she had grown up.
https://www.abc.net.au/news/2019-12-14/julie-radford-is-victorias-orchid-whisperer/11788832

Tasmania's flowering giants: 'We will never see such trees again'

Many of Tasmania's giant trees suffered in the summer fires of 2019 and now lie in ruins. In Australia's island state of Tasmania, many of the world's biggest flowering trees lie in ruins after this year's bushfires. The Arve Giant, a eucalyptus regnans ("king of the eucalypts"), had attracted hundreds of thousands of visitors in recent decades, but it succumbed in January. Adventure photographer Steve Pearce recently photographed the collapsed giant. Before its fall, it was a contender for the world's biggest flowering tree by volume at 360 cubic metres, which is roughly the equivalent volume of three Boeing 737-300s.
https://www.theguardian.com/environment/2019/dec/15/tasmanias-flowering-giants-we-will-never-see-such-trees-again

Massive Kosciuszko feral horse numbers a national disaster

New survey data on the number of feral horses in Kosciuszko National Park has shocked conservationists, scientists, tourism operators and former park managers. "We knew the horse population was growing rapidly. But these numbers are much worse than we expected. Kosciuszko is now a horse park, not a national park," said Invasive Species Council CEO Andrew Cox. "In the lead-up to the March election Deputy Premier John Barilaro promised 'immediate' action to reduce by half the park's feral horse population. "Yet the latest survey reveals his government has overseen a tripling of horse numbers over the past five years. "At a conservative estimate we believe there are now at least 20,000 horses in Kosciuszko National Park, up from 6150 five years ago and with more than 25,000 horses across the entire Australian Alps. **https://invasives.org.au/media-releases/kosciuszko-2019-feral-horse-survey/**

Using forest therapy to restore the person and the landscape

Bush Connections mixes nature therapy with land conservation techniques to build lasting benefits for people with disabilities, whilst restoring the hidden gem of Greswell Forest. The results are measurable. Bush Connections facilitator Nita McIntyre and Vic Parks ranger Simeon Buckley work together in helping people with intellectual disabilities, who are often non-verbal, to create a sense of place in a piece of pre-colonial forest that springs to life under their care. Their work has allowed native orchids to once again bloom in open woodland, and participants have made a bush shelter, where they gather for tea ceremonies three times a week. **https://www.abc.net.au/radionational/programs/lifematters/using-forest-therapy-to-restore-the-person-and-the-land/11780428**

Meet Ilma Stone, who studied Australian moss for almost 60 years

Those outside of science may not know the name Ilma Stone, but her ability to see what would otherwise be invisible, opened our eyes to the diversity of moss in Australia. Much of what we know about Australian mosses comes from the remarkable work of a diminutive, curly-haired Melbournite born in 1913, named Ilma Stone. Because of the 70 scientific papers she published, we can now explore the tropical mosses of North Queensland through to those of the arid regions of Australia. Mosses – seemingly unexceptional components of ecosystems – are, in truth, among the most beautifully diverse types of plants, not to mention, ecologically important. They are key environmental indicators, and stories such as the dying "moss forests" of Antarctica have been critical to understanding the impact of human-induced global heating on the planet. **https://www.australiangeographic.com.au/topics/history-culture/2019/12/meet-ilma-stone-who-studied-australian-moss-for-60-years/ .**

Herbarium specimens survey

Herbarium specimens have recently been proposed to be source of viable propagules (spores and seeds), which can provide native germplasm for recovering lost genetic variation, including species lost from the wild. Although there are no documented examples of the use of herbarium material for plant de-extinction, a few attempts with locally extirpated species demonstrate the potential of herbaria for such actions. This short survey (12 questions) aims to assess different points of view in the use of herbarium specimens for plant de-extinction purposes. With this survey we aim to understand which is the general opinion about de-extinction and more specifically whether taxonomists, conservation biologists and herbaria/museum curators would allow detaching small parts (fruits, seeds, spores referred to as "diaspores" hereafter) from herbarium specimens with the aim to try de-extinction. Complete the survey here **https://docs.google.com/forms/d/e/1FAIpQLScWnZCY2P_7Eest5J31wQaJmnZBaUOrrhZpvl24LM-bznWZ7g/viewform**

Sydney's Botanic Gardens works out what to save and what to let go

To Jimmy Turner, the living botanical treasures of Sydney's Royal Botanic Gardens and Centennial Parklands are more valuable than the Mona Lisa and black rhinos, and more important to the world's future. "Wherever there is nature there is hope," tweeted Mr Turner, the director of the garden's horticultural management. Reflecting on the bushfires and destruction, he urged the public to choose to be part of the solution rather than cast blame. "Nature is telling us something. I intend to listen and change accordingly. Will you join me?" he asked, using the hashtag, #PlantsNotPolitics. **https://www.smh.com.au/national/nsw/sydney-s-botanic-garden-works-out-what-to-save-and-what-to-let-go-20200102-p53oex.html**

Western Australia bushfires devastate the Stirling Ranges — one of the world's richest biodiversity hotspots

Rare and unique flora and fauna in Western Australia's Stirling Range may never fully recover from a massive series of fires which devastated the national park, which is considered one of the world's most important biodiversity hotspots. Sparked by lightning, intense fires tore through more than 40,000 hectares of land in the park, about 400 kilometres south-east of Perth, between Boxing Day and the New Year. The series of fires left almost half the rugged park scorched.
https://www.abc.net.au/news/2020-01-07/bushfires-cause-stirling-ranges-biodiversity-to-be-devastated/11844516

'Disturbing and dramatic': Ecosystems may never recover from bushfires

Some ecosystems across Australia's eastern seaboard will never recover from the damage wrought by this season's bushfires and several animal and plant species are now feared critically endangered or extinct....The Department of Environment, Land, Water and Planning will on Friday host an emergency summit of environmental scientists, biologists and conservation managers from across the country, to establish seed banks for rare plants, breeding programs and canvass how best to protect animals and plants that have survived fires....DELWP has also established emergency wildlife and biodiversity teams, to lead people into burnt forest areas as quickly as possible.
https://www.smh.com.au/national/disturbing-and-dramatic-ecosystems-may-never-recover-from-bushfires-20200109-p53q4y.html

Leaked report lays bare environmental devastation of Victorian fires

The ecological devastation of the Victorian bushfires has been laid bare in a leaked report which warns some species are likely to already be extinct – even as authorities brace for many more weeks of fires....It warned that 31 per cent of the state's rainforests had already gone up in flames, as well as 24 per cent of wet or damp forests, and 34 per cent of lowland forests....Leading conservation biologist Professor David Lindenmayer said it would take more than 100 years for wet and damp forests to recover from the ferocity of this season's fires. Of more concern was the increasing severity and regularity of fire seasons, with many of the areas that have already burnt or which are predicted to burn in 2020 being ravaged as recently as 2014. "A lot of these areas won't even have started to recover from the last fire before they get smashed again by another fire, and they won't go back to what they were," Professor Lindenmayer said. "They just collapse into something different."
https://www.theage.com.au/national/victoria/leaked-report-lays-bare-environmental-devastation-of-victorian-fires-20200110-p53qep.html

Greening Australia to lead $5M native seed and restoration program as part of bushfire recovery

The Federal Treasurer and Minister for the Environment have today announced an initial $50 million investment in an emergency response to the devastating bushfires for wildlife and habitat recovery. $25 million has been allocated for an emergency intervention fund, while a further $25m will be made available to support wildlife rescue, zoos, natural resource management groups, Greening Australia and Conservation Volunteers Australia. $5 million of this initial investment will see Greening Australia lead the development of a strategic program to build and secure native seed and plant supply for landscape restoration, recovery and resilience in bushfire impacted areas and other vulnerable landscapes.
https://www.greeningaustralia.org.au/greening-australia-to-lead-5m-native-seed-and-restoration-program-as-part-of-bushfire-recovery/

Wildlife needs fire-damaged and dead trees after fires

According to a group of leading Australian environmental scientists the remains of trees damaged in fires will be vital for the recovery of our flora and fauna. Rather than the mess they appear to be, fire-damaged trees and half burnt logs are valuable habitat for recovering wildlife, explains Professor David Lindenmayer from the Fenner School of Environment & Society at the Australian National University. "Wanting to do something constructive, people and organisations may sometimes feel an urge to clean these up, but resisting this urge can be one of the best things people can do for wildlife," David says. "Fires burn patchily and small unburnt patches, half burnt logs and dead or fire-damaged trees are commonly left behind. Our research has demonstrated that these patches and remaining woody debris are very important to recovering wildlife populations. We have found that when burnt areas contain small unburnt patches – even as small as a single surviving tree – it helps an area recover much faster."
https://www.australiangeographic.com.au/topics/science-environment/2020/01/wildlife-needs-fire-damaged-and-dead-trees-after-fires/

Incredible, secret firefighting mission saves famous 'dinosaur trees'

Desperate efforts by firefighters on the ground and in the air have saved the only known natural grove of the world-famous Wollemi pines from destruction during the record-breaking bushfires in NSW. The rescue mission involved water-bombing aircraft and large air tankers dropping fire retardant. Helicopters also winched specialist firefighters into the remote gorge to set up an irrigation system to increase the moisture content of the ground fuels to slow the advance of any fire. "It was like a military-style operation," NSW Environment and Energy Minister Matt Kean told the Herald. "We just had to do everything."
https://www.smh.com.au/environment/conservation/incredible-secret-firefighting-mission-saves-famous-dinosaur-trees-20200115-p53rom.html?utm_medium=Social&utm_source=Facebook&fbclid=IwAR1UcVTDJ3S-UxRMvsR-zqPn4xYz3e3AVOUPFWd_Kim-93AvVhNwdQyTp-M#Echobox=1579066524

Prehistoric Wollemi pines saved by firefighters from Australia's bushfires – video

Australia's Wollemi pines survived the dinosaurs and now firefighters have nursed them through the country's unprecedented bushfire season to live another day. When seen from above – among acres of charred, native forest – there's a thin trail of green. Firefighters were winched in by helicopter to activate irrigation systems, while other aircraft dropped water and retardant along the flames' edge to minimise their impact. The giant trees were thought to be extinct until 1994, when authorities found 200 of them in a national park near the Blue Mountains, north-west of Sydney.
https://www.theguardian.com/global/video/2020/jan/16/prehistoric-wollemi-pines-saved-by-firefighters-from-australias-bushfires-video

'It's heart-wrenching': 80% of Blue Mountains and 50% of Gondwana rainforests burn in bushfires

At least 80% of the Blue Mountains world heritage area and more than 50% of the Gondwana world heritage rainforests have burned in Australia's ongoing bushfire crisis. The scale of the disaster is such that it could affect the diversity of eucalypts for which the Blue Mountains world heritage area is recognised, said John Merson, the executive director of the Blue Mountains World Heritage Institute....The Blue Mountains world heritage area covers one million hectares of national park and bushland and is dominated by temperate eucalypt forest. The area is renowned for the diversity of its vegetation and is home to about a third of the world's eucalypt species. While most are fire-adapted and can regenerate, many of the species depend on long intervals between fires, Merson said. "We had a very large fire in 2013. It's only six years after that," he said.
https://www.theguardian.com/environment/2020/jan/17/its-heart-wrenching-80-of-blue-mountains-and-50-of-gondwana-rainforests-burn-in-bushfires

Revealed: Widespread species devastation following 'unprecedented' fires

More than a third of NSW's national park land has been burnt by this season's "unprecedented" bushfires, potentially pushing dozens of threatened species including the long-footed potoroo to extinction in the wild. The Berejiklian government's first assessment of the fires' impact on the state's wildlife, obtained by the Sun-Herald, also reveals about 80 per cent of the Blue Mountains World Heritage Area has been affected and more than half the Gondwana Rainforests. A separate, shorter report shared with staff on Friday and posted online without fanfare, said the bushfires were "unprecedented in their extent and intensity". As of January 10, they had burnt 5.128 million hectares of NSW, including 2.539 million hectares - or 34.5 per cent of the national park estate. More than half of the state's heathlands were torched, as were 41 per cent of wet sclerophyll forests and - as a measure of the state's acute drought - more than a third of NSW's rainforests. Even saline wetlands burned.
https://www.smh.com.au/environment/conservation/revealed-widespread-species-devastation-following-unprecedented-fires-20200117-p53siy.html

Seed bank throws lifeline to fire-threatened species

The survival of up to 30 plant species in Victoria's bushfire-ravaged areas is under threat. But there may be a saviour. In the centre of Melbourne and in the city's west, three scientists are working to preserve seeds from rare plants before they become extinct. The bushfires have made their work vital and now the federal government has invested millions of dollars into the creation of a national project that will fund similar projects around Australia. Potentially dozens of plant species in Victoria are at risk of becoming extinct because of climate change and the recent bushfires. "Something in the order of 20 to 30 species, I reckon, have a very, very precarious future under current conditions and with what we know at the moment" Dr Neville Walsh says.
https://www.theage.com.au/national/victoria/seed-bank-throws-lifeline-to-fire-threatened-species-20200117-p53sd6.html

After the fire: The challenge of bringing the bush back to life

While the mega-fire burning in the world heritage Blue Mountains near Sydney is finally under control, it appears that some of the region's unique plants and animals may have been burnt into extinction. Local plant and animal rescue groups are swinging into action to help with recovery, but one expert is warning that the mountains environment may never recover.
https://www.abc.net.au/radio/programs/australia-wide/australia-wide/11853710

Be a detective: Citizen science project into tree deaths

Swathes of trees in multiple areas of the Mid-Western Region - and indeed across the state - look like they've burnt by fire even though no such event has occurred, and a research project is asking locals to help document this. The Dead Tree Detective is a citizen science project, run by researchers from the Western Sydney University, to collect observations of dead or dying trees around Australia. It was set-up over a year ago to help better understand the physiology of tree mortality. However, as the drought wore-on Associate Professor Brendan Choat said that photos submitted started to show larger-scale patches of dead trees - including natives. "There are a lot of things associated with die back; fungal pathogens; various insects and pests, bark beetles; climate; soil moisture; frost; and fire," he said. "But what's happened is it's been the hottest and driest year on record. So we started off getting pictures of isolated trees that had turned brown, then as the months rolled on we started getting pictures of whole hillsides full of dead trees.
https://www.mudgeeguardian.com.au/story/6584396/be-a-detective-citizen-science-project-into-tree-deaths/?cs=1485&fbclid=IwAR1_CvxD6myXWUYTvQTtHA3O_SeYrh4e7bi-o644M3Te0tjE1yG0iKoTvpA

More than 100 threatened species hit hard by Australian bushfires, pushing many towards extinction

Nearly 50 nationally threatened animal and plant species are believed to have had at least 80% of the area in which they live affected by bushfire, a federal environment department analysis has found. Another 65 have had more than half their area in the fire zone. Scientists have warned some affected species could be pushed to extinction. The worst affected mammal is believed to be the Kangaroo Island dunnart, an endangered mouse-like marsupial endemic to the 160km long South Australian island. It is one of 49 species, including 47 plants and one spider, that have had at least 80% of their likely and known range within fire-hit areas. Seven of the plant species, including the nightcap oak and three types of leek orchid, are critically endangered.
https://www.theguardian.com/environment/2020/jan/20/more-than-100-threatened-species-australian-bushfires-towards-extinction

Bushfires affect habitat of more than 100 threatened species, department estimates

The recent bushfires are estimated to have burned at least half the habitat of more than 100 threatened species, but experts warn government calculations are likely to fall short because of underfunding of environmental work. An early analysis released on Monday by the federal Environment Department found bushfires swept through more than 80 per cent of the known habitat of 49 listed species, and at least 50 per cent of the habitat of another 65 listed species. But University of Sydney professor of ecology and evolution Glenda Wardle said a lack of funding for boots-on-the-ground monitoring of plant and animal species over many years meant there were likely to be significant gaps in the department's figures. "The funding and recovery plan for the fires means the department is doing some good due diligence," she said. "But the department is effectively acknowledging its lack of knowledge about species distribution as well as how that interacts with other impacts like ferals and land clearing."
https://www.smh.com.au/politics/federal/bushfires-affect-habitat-of-more-than-100-threatened-species-department-estimates-20200120-p53t0i.html

Tasmania's montane conifers, including King Billy and pencil pine, fruit for first time since 2015

Theories abound, but there is no hard and fast way to tell when certain kinds of trees will fruit — the only thing you can be sure of is that it does not happen very often. Tasmania's montane conifers — several species of which are endemic to the state — last propagated, or masted, in 2015, sending researchers scrambling to collect their seeds. Now the trees are at it again, but the seeding is not just confined to the Apple Isle, or even Australia. "Masting events like this appear to be global, with conifers seeding in New Zealand and other parts of the world," said the Tasmanian Seed Conservation Centre's (TSCC) James Wood. "The most recent modelling on masting suggests that the last two warm summers may have contributed to this event.
https://www.abc.net.au/news/rural/2020-01-14/tasmanian-conifers-fruit-for-first-time-in-years/11858284

'Millstone': Environmental funding cuts to hinder fire recovery plans

Leading ecologists say decades of underspending on environmental research mean governments will likely struggle to assess the impact on wildlife from the huge bushfires l*et al.*one develop effective recovery plans. The assessment comes days after the Victorian and NSW governments developed initial responses to the fires, and the Morrison government declared as many as 100 threatened species had lost at least half their habitat. The Australian Conservation Foundation said federal Coalition governments had sliced 40 per cent off the Environment Department's budget since 2013, with more loss of staff likely once it is merged with the Department of Agriculture. "Governments have viewed the environment as a millstone...dragging back progress," Richard Kingsford, director of the University of NSW's Centre for Ecosystem Science, said.
https://www.smh.com.au/environment/conservation/millstone-environmental-funding-cuts-to-hinder-fire-recovery-plans-20200121-p53tal.html

Conservation scientists are grieving after the bushfires – but we must not give up

That a billion animals may die as a result of this summer's fires has horrified the world. For many conservation biologists and land managers, however, the unprecedented extent and ferocity of the fires has incinerated much more than koalas and their kin. The scale of the destruction has challenged what is fundamentally an optimistic worldview held by conservationists: that with sufficient time and money, every species threatened by Australia's 250 years of colonial transformation cannot just be saved from extinction, but can flourish once again. The nation's silent, apocalyptic firescapes have left many conservation biologists grieving – for the animals, the species, their optimism, and for some, lifetimes of diligent work.
https://theconversation.com/conservation-scientists-are-grieving-after-the-bushfires-but-we-must-not-give-up-130195

Bushfire impact on Australian plants

How do native plants cope with bushfires? Most Australian plants are fire-adapted and have strategies to cope with fire. Some species even take advantage of bushfires to germinate. Recent bushfires have affected 272 plant species with 22 of those listed as critically endangered. And for 47 plant species, the bushfires have damaged at least 80 per cent of their habitat. The 2003 Canberra bushfire burnt sites in natural bushland where we had been studying plant biodiversity. Ten years after the bushfires, our tracking revealed the plants were doing well. Native plant species were able to re-establish because their seeds were protected in soil or held on the plants.
https://blog.csiro.au/bushfire-impact-on-australian-plants/?fbclid=IwAR0V-EtxkokSXHfE-rg82NgDq5qDDC69-jXyp-bhjqqOD6dYyOXqmuVIoME

Many of our plants and animals have adapted to fires, but now the fires are changing

Australia is a land that has known fire. Our diverse plant and animal species have become accustomed to life with fire, and in fact some require it to procreate. But in recent decades the pattern of fires – also known as the fire regime – is changing. Individual fires are increasingly hotter, more frequent, happening earlier in the season and covering larger areas with a uniform intensity. And these changes to the fire regime are occurring too fast for our native flora and fauna to adapt and survive. Our fire-adapted plants are suffering. Many of Australia's iconic eucalypts are "shade intolerant" species that adapted to exist within a relatively harsh fire regime. These species thrive just after a major fire has cleared away the overstory and prepared an ash bed for their seeds to germinate. Some of our most majestic trees, like the alpine ash, can only regenerate from seed. Those seeds germinate only on bare earth, where the leaf litter and shrubs have been burnt away. But if fire is so frequent the trees haven't matured enough to produce seed, or so intense it destroys the seeds present in the canopy and the ground, then even these fire-adapted species can fail.
https://theconversation.com/many-of-our-plants-and-animals-have-adapted-to-fires-but-now-the-fires-are-changing-129754 .

A conservation response to the 2019-20 wildfires

With other concerned conservation biologists, researchers from the Threatened Species Recovery Hub have developed a 'blueprint' for management responses to the 2019-20 wildfires. This document is a response to the profound impacts of these fires on many threatened plant and animal species, and it reflects our hub's primary objectives – to enhance the conservation of Australia's threatened species (and ecological communities) and to provide evidence and advice to the community and many other stakeholders about such conservation. The purpose of this document is to try to describe and justify the immediate, short- and longer-term responses to these fires. It seeks to provide the broad context for connecting and prioritising these responses. In 'fog of war' situations, such as these fires, there is a need for actions to be coordinated, purposeful and strategic. In this case, there is

a priority for urgent response for animal welfare concerns, but also an even more important priority for long-term management, planning and policy refinement to provide the greatest prospect of environmental recovery.
http://www.nespthreatenedspecies.edu.au/news/a-conservation-response-to-the-2019-20-wildfires?fbclid=IwAR2aiDdy9ge_rn8H-L8vPmg4XH_EE-1eGGqUZRpuEfglKLYgCdfmwztyNA8

Why prescribed burns don't stop wildfires

The Prime Minister has declared hazard-reduction burning is just as important as action on climate change to limit Australia's wildfire risk – but with lives, properties, flora and fauna at real risk, it is critical to understand the realities and limitations of fire management. Prescribed burns are fires created by fire-management authorities to reduce fuel in an attempt to stop the advance of future possible wildfires. Unfortunately, areas in the devastated fire zones that recently had prescribed burns offered little resistance to the advance of the latest wildfires. The fires simply passed straight through them. But why? Current practices of prescribed fires essentially burn the ground flora, the shrubs, herbs and creepers. At most, heat from the ground might scorch the upper canopy. It tends to be patchy. These are called surface fires. But wildfires burn everything.
https://www.smh.com.au/environment/climate-change/why-prescribed-burns-don-t-stop-wildfires-20200122-p53tl9.html?fbclid=IwAR0Dl4NZnbGhdZOy8ipzsAY-oGJrWb_JmAm2-GHFtOyDY2Aj56Gwj3MghA4

Pulling out weeds is the best thing you can do to help nature recover from the fires

Many Australians feel compelled to help our damaged wildlife after this season's terrible bushfires. Suggested actions have included donating money, leaving water out for thirsty animals, and learning how to help the injured. But there is an equally, if not more, important way to assist: weeding. An army of volunteers is needed to help land owners with judicious weed removal. This will help burnt habitats recover more quickly, providing expanded, healthy habitat for native fauna. Other emergency responses, such as culling feral animals and dropping emergency food from aeroplanes, are obviously jobs for specialists. But volunteer weeding does not require any prior expertise – just a willingness to get your hands dirty and take your lead from those in the know.
https://theconversation.com/pulling-out-weeds-is-the-best-thing-you-can-do-to-help-nature-recover-from-the-fires-130296

Fire almost wiped out rare species in the Australian Alps. Feral horses are finishing the job

On Friday I flew in a helicopter over the fire-ravaged Kosciuszko National Park. I was devastated by what I saw. Cherished wildlife species are at grave risk of extinction: those populations the bushfires haven't already wiped out are threatened by thousands of feral horses trampling the land. The New South Wales park occupies the highest mountain range in Australia and is home to plants and animals found nowhere else in the world. Many of these species are threatened, and their survival depends on protecting habitat as best we can...As the climate has warmed, the cool mountain habitat of these species is shrinking; bushfires have decimated a lot of what was left. Feral horses now threaten to destroy the remainder, and an urgent culling program is needed.
https://theconversation.com/fire-almost-wiped-out-rare-species-in-the-australian-alps-feral-horses-are-finishing-the-job-130584

Want to help the bushfire recovery? This citizen science project is easy and free

Casey Kirchhoff's home was one of the thousands that were lost in Australia's horrific summer of bushfires, where more than one million hectares were burnt, more than twenty people died, and at least 1 billion animals perished. For Casey, coming back to her place in Wingello - a few hours South of Sydney - was almost indescribable. "Seeing it and knowing it's a place you loved...I can't find the word for it - it's shattering, really." An ecologist and PHD candidate at the University of New South Wales, Casey has felt the devastation especially deeply, as studying Australian flora is her life's work. But while the bush around her home is burnt and blackened, Casey has managed to focus on looking forward - and finding solace in the bright green life already sprouting through the ash at her feet.
https://www.abc.net.au/triplej/programs/hack/citizen-science-project-bushfire-recovery-needs-your-help/11910486?fbclid=IwAR25jC6urgDAFMMZS59TFMSAMZtsgWJwD6VhsVjg6f_6gAE3hmDB-9DqRCg

Other conferences, courses and events

Updates available at
http://anpc.asn.au/other_conferences_and_events

22nd Australian Weeds Conference – New dates announced 10-13 October 2021

The Weed Management Society of South Australia (WMSSA) with the support of Council of Australasian Weeds Societies Inc. (CAWS) have decided to postpone the 22nd Australasian Weeds Conference (22AWC) due to the COVID-19 Coronavirus pandemic. The WMSSA and CAWS look forward to co-hosting the event next year and are excited to announce a new date at our venue Adelaide Oval on 10-13 October 2021. We are now looking forward with optimism to 2021. By delaying the event, we will progress with confidence in our ability to host the conference that everyone knows and loves at a time when society is more positive and secure (note that we will also continue to monitor all advice from the Australian Government and heed their future directive). **http://wmssa.org.au/22awc-new-dates-announced/**

NSW Nature Conservation Council's 2020 Bushfire Conference - Sydney NSW, May 2021

In light of public health advice on the Novel Coronavirus (COVID-19) we are unfortunately postponing the Nature Conservation Council of NSW's Bushfire Conference scheduled for the 19-20 May 2020 at the NSW Teachers Federation Conference Centre in Sydney until next May 2021 (date to be confirmed). We have made this decision for the safety of our delegates and to assist in safeguarding the wider community. The rationale for deferral to May 2021 is primarily due to the uncertainty about the ongoing impact of COVID-19 and the potential for bushfires to cause disruption to presenters and delegates during the 2020-21 fire season. We recognise that many people were anticipating that this "Cool, warm, hot: the burning questions" conference would provide an important opportunity to discuss and learn at first hand ways to better understand and manage the effects of fire in our cherished environment, particularly after the recent devastating fire season. The conference will still act as a valuable platform, with additional time for recovery, reflection and learnings from the fires to be shared in May 2021.
https://www.nature.org.au/healthy-ecosystems/bushfire-program/bushfire-conference-2020/

Research round up

COMPILED BY TOM LE BRETON

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